Welch Allyn

Service Manual

Micro Tymp 2
Tympanometric System

23640 handle, 71170 printer charger
(Includes CE Model)

4341 State Street Road
P.O. Box 220
Skaneateles Falls, NY 13153-0220

Part #: 236409

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Part	Rev	Desc. of Change	ECN #	Date	Initiator
236409	B	New Release	5-28225	6/95	R. Settembre
236409	C	Added CE Updates & Cautions	5-35489	6/97	R. Settembre

NOTE: Drawings & illustrations in this document are for reference only. Consult system or call factory for latest revisions.

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Service Manual Part #:236409

FORWARD

This manual provides technical assistance for calibrating, diagnosing, and servicing the Welch Allyn MICROTYMP 2 handle and Printer/Charger.

The MicroTymp 2 and or Printer Charger will be returned to the Technical Service Department for either Recalibration (handle only) or for diagnosis and repair. For Printer Charger tests, refer to current factory approved diagnostic tests. Once the fault has been determined, refer to the Manual chapters I and J for the appropriate Removal and Replacement sequence. Re-test the Printer Charger after the repair is completed. Similarly, when servicing the MicroTymp 2 handle, refer to the most recent troubleshooting guide and Calvin Users guide. Once the failed component has been identified, refer to the Manual chapters B through H for the appropriate Removal and Replacement sequence. Re-test (re-calibrate) the handle once the repair has been completed.

The repair 'TASK' procedures (R & R .. Removal and Replacement) are written to provide quick and easy reference for different experience levels of repair technician. Required specifications and materials are listed at each step where applicable. For example:

Instructions will start off with a "TASK, TO DO." For example, B. 3. "Unplug Flex Circuit" statement. This will be followed by a "TECHNIQUE, HOW TO DO" statement. Follow these steps to preform the task.— "Grasp pump assembly flex circuit with pin straightening pliers."

This manual is written in a style useful for training and or translation. Set up training sessions to allow the trainee to practice the use of the diagnostic, repair, adjustment, and re-testing procedures found in this manual. Set up hands-on practice sessions to enable the technician to develop and retain skills. Provide each trainee with the opportunity to practice the procedure(s) after it has been demonstrated by the instructor.

I M P O R T A N T :

Welch Allyn service part numbers and material numbers appearing in this manual are for the purpose of familiarizing new technicians with the Welch Allyn parts numbering system. Order replacement parts, as always, by referencing your latest bill of materials, parts catalog and assembly drawings. Part number changes, product updates, or new test procedures should be noted on the appropriate page of this manual by the manual owner.

*** SAFE SERVICE ***

CLEAN AND DISINFECT per instructions in MicroTymp2 Operating Instructions PN 236311 PAGE C-50 prior to repairing, or calibrating all returned MicroTymp 2's.

PERFORM appropriate "A" tests after servicing to assure safe, accurate and reliable product operation.

*** QUALITY SERVICE ***

WEAR an ESD wrist strap when servicing the MicroTymp 2 or handling printed circuit boards.

STORE new and used boards in anti-static bags.

UPDATE your Repair & Training Manual by notating changes and revisions of part numbers and procedures.

READ AND UNDERSTAND customer comments and complaints on accompanying documentation (P.O. or other correspondence).
If an injury, illness to patient or user, or hazardous malfunction has occurred or is suspected, PROCEED NO FURTHER ! **DO NOT** disassemble, repair, adjust, or in any way alter the MicroTymp 2 or the printer charger base ... instead, notify your supervisor at once. Give them all accompanying paperwork and any information you might have on the return. They will take appropriate action according to Welch Allyn policy. Check customer service records to determine if this MicroTymp 2 requires or has received any applicable retrofit modifications, improvements, or inspections, and perform these if required.

INSPECT AND TEST it before and after it is repaired. Documentation should include: general condition, defects, missing components and labels, electrical, functional and mechanical problems. Operate the returned instrument to try to duplicate the customer's complaint before and after it is repaired.

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A **NORMAL MAINTENANCE : BATTERY COVER, BATTERY, RECHARGING BATTERY, RECYCLING THE USED BATTERY**

A 1. **REFER** TO PAGE C-43 THROUGH C-47 OF MICROTYMP 2 OPERATING INSTRUCTIONS FOR REPLACEMENT OF BATTERY PN72900.

WARNING: INSERT BATTERY ONLY AS SHOWN IN THE OWNERS MANUAL. FAILURE TO OBSERVE CORRECT POLARITY COULD CAUSE DAMAGE TO THE MICRO TYMP 2. WHEN IT IS NECESSARY TO REPLACE THE BATTERY, USE ONLY A WELCH ALLYN PN72900 REPLACEMENT BATTERY. OTHER NON APPROVED BATTERIES MAY CAUSE RISK OF FIRE OR PRODUCT FAILURE.
CAUTION: The battery must be removed if the MicroTymp 2 is to be stored or placed anywhere other than in the Charging Stand (or connected to the Charging Transformer) for more than one month. Failure to do this can result in damage to BOTH the battery and the MicroTymp 2.

A 2. FOLLOW THIS PROCEDURE FOR DECIDING WHEN TO REPLACE THE NI-CAD BATTERY IN A MICRO TYMP HANDLE: (AS ALWAYS, READ THE CUSTOMER COMPLAINT FIRST.)

SCENARIO 1 If the unit **FUNCTIONS**, (the battery has held sufficient charge during approximately two days transit) the battery meets requirements. No corrective action is to be taken. However, it is good practice to put the battery on charge for however long it is in your possession.

OR

SCENARIO 2 a If the unit **DOES NOT FUNCTION** AND the battery **is IN warranty**, put in a fully charged new battery (your test battery). If the unit functions, and Low Battery symbol disappears, REPLACE THE BATTERY UNDER WARRANTY. Install a fully charged BATTERY. Recycle the failed battery per Welch Allyn's recycling policy.

2 b If the unit **DOES NOT FUNCTION AND** the battery **is OUT of warranty,** put in a fully charged new battery (your test battery). If the unit functions, sell a new battery. If the unit does not function, look for other problems while charging the customer's battery. Sell a new battery if customer's battery won't ACCEPT AND HOLD a full charge.

NOTES:

NOTE: WEAR ESD WRIST STRAP WHILE PERFORMING THE FOLLOWING OPERATIONS.

B **POWER SUPPLY BOARD (TOP BOARD) ASSEMBLY**

B 1. **REMOVE** BATTERY COVER.
FOLLOW INSTRUCTIONS IN MICROTYMP 2 OPERATING INSTRUCTIONS TO REMOVE BATTERY COVER AND BATTERY. IT IS NOT NECESSARY TO REMOVE THE FRONT HOUSING ASSEMBLY FOR POWER SUPPLY BOARD REPLACEMENT.

B 2. **DISCONNECT** TUBING FROM TOP BOARD.
REMOVE TUBING FROM MOTOR/PUMP ASSEMBLY.
REMOVE TUBE FROM BALLAST.

B 3. **UNPLUG** FLEX CIRCUIT.
GRASP PUMP ASSEMBLY FLEX CIRCUIT WITH PIN STRAIGHTENING PLIERS. **PULL** STRAIGHT UP TO REMOVE FLEX CIRCUIT FROM THE POWER SUPPLY BOARD.

B 4. **REMOVE** POWER SUPPLY BOARD.
UNSCREW 4 PHILLIPS HEAD SCREWS AT THE FOUR CORNERS OF ` THE POWER SUPPLY BOARD. **LIFT** THE CONTACTS FROM THE CASE AND **LIFT** POWER SUPPLY BOARD STRAIGHT UP.

REPLACE POWER SUPPLY BOARD

B 4. **REPLACE** POWER SUPPLY BOARD.
ATTACH TUBING TO THE PUMP AND THE BALLAST. **REFER** TO TUBING ROUTING DIAGRAM ON DRAWING 236300. **ALIGN** BOARD OVER STAND-OFFS WITH BATTERY HOLDER NEAR THE BOTTOM OF THE HANDLE. **SCREW** THE BOARD TO THE STRAIN RELIEFS WITH TWO LONG SCREWS AT THE BOTTOM OF THE BOARD, AND TWO SHORT SCREWS AT THE TOP OF THE BOARD.

B 5. **PLUG IN** FLEX CIRCUIT.
PLUG FLEX CIRCUIT INTO BOARD USING PIN STRAIGHTENING PLIERS OR FINGERS. IF THE TWO FIBER SEPARATORS BECOME LOOSE, **RE-CONNECT** THEM IN THEIR ORIGINAL POSITION (**REFER** TO ASSEMBLY DRAWING) WITH LOCTITE BLACK MAX ADHESIVE M-30341.

B 6. **CALIBRATE** HANDLE WITH CALVIN.
REFER TO SECTION 6 FOR CALVIN PROCEDURE. UPON SUCCESS-FUL CALIBRATION AND TEST, **PLACE** A DROP OF BLACK MAX tm ADHESIVE M-30341 BETWEEN THE FRONT HOUSING AND THE FIBER STRIPS. **REPLACE** BATTERY AND BATTERY COVER.
SCREW BATTERY COVER IN PLACE.

END POWER SUPPLY BOARD REPLACEMENT

NOTES:_____

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C **MOTOR/PUMP ASSEMBLY**

C 1. **REMOVE** BATTERY COVER AND BATTERY.
UNSCREW BATTERY COVER SCREW AND **REMOVE** THE COVER.
REMOVE THE BATTERY FROM THE BATTERY HOLDER.

C 2. **REMOVE** FRONT HOUSING ASSEMBLY.
PEEL THE WELCH ALLYN LABEL FROM THE UNIT AND **UNSCREW** TWO SCREWS UNDER THE LABEL. **REMOVE** THE FRONT HOUSING ASSEMBLY FROM THE HANDLE. **DO NOT UNPLUG** FLEX CIRCUIT FROM LCD BOARD.
NOTE: If unit is a CE model, take caution in removing the front housing. There are two pieces of fragile ESD tape at both corners.

C 3. **REMOVE** TUBING FROM MOTOR/PUMP ASSEMBLY.
PULL TUBE FROM THE PUMP. **PULL** TUBE FROM THE BALLAST. **DISCONNECT** FLEX CIRCUIT FROM SWITCHES BOARD AND POWER SUPPLY BOARD. **GENTLY LIFT** MOTOR/PUMP ASSEMBLY UP.

REPLACE MOTOR PUMP ASSEMBLY

C 4. **REPLACE** MOTOR/PUMP ASSEMBLY.
INSTALL REPLACEMENT PRE/ADJUSTED MOTOR/PUMP ASSEMBLY OVER LCD RETAINER. **RE-ATTACH** FLEX CIRCUITS TO POWER BOARD AND SWITCH BOARD. **USE** PIN STRAIGHTENING PLIERS OR FINGERS TO RE-ATTACH FLEX CIRCUITS. **RE ATTACH** FRONT HOUSING ASSEMBLY. **LAY** FLEX CIRCUITS IN ACCORDING TO DRAWING #236300.

C 5. **CALIBRATE** HANDLE WITH CALVIN.
REFER TO SECTION 6 FOR CALVIN PROCEDURE. UPON SUCCESSFUL CALIBRATION AND TEST, **PLACE** A DROP OF BLACK MAX tm ADHESIVE M-30341 BETWEEN THE FRONT HOUSING AND THE FIBER STRIPS. **REPLACE** BATTERY AND BATTERY COVER. **SCREW** BATTERY COVER IN PLACE.

NOTES:_____

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D **MCU (BOTTOM) BOARD**

D 1. **REMOVE** POWER SUPPLY BOARD (TOP BOARD).
FOLLOW INSTRUCTIONS IN SECTION B FOR REMOVAL OF POWER SUPPLY BOARD.

D 2. **UNPLUG** FLEX CIRCUIT FROM MCU BOARD (BOTTOM BOARD).
USE PIN STRAIGHTENING PLIERS OR FINGERS TO GENTLY **PULL** THE FLEX CIRCUIT FROM THE MCU BOARD SOCKET.

D 3. **REMOVE** MCU BOARD.
UNSCREW FOUR STANDOFFS WITH 1/8" NUT DRIVER. GENTLY **PULL** THE BOARD STRAIGHT OUT OF THE HOUSING. FOUR PLASTIC SPACERS ARE ATTACHED TO THE BOARD AT EACH SCREW HOLE. **TRANSFER** THESE TO THE REPLACEMENT MCU BOARD.

D **MCU (BOTTOM) BOARD**

D 4. **REPLACE** MCU BOARD.
INSTALL FOUR PLASTIC SPACERS ON THE BOTTOM OF THE BOARD. **INSERT** REPLACEMENT BOARD INTO HANDLE WITH INFRA-RED LED AT BASE OF HANDLE FACING IR WINDOW. **SCREW** FOUR STANDOFFS INTO CORNERS OF MCU BOARD. **TIGHTEN** TO 1.5 TO 2 INCH LBS.

D 5. **PLUG** IN FLEX CIRCUIT.
CONNECT THE FLEX CIRCUIT TO THE MCU BOARD SOCKET. **INSERT** SIDE CONTACTS INTO THE SLOTS OF THE BACK HOUSING WITH THE BLACK WIRE ON THE RIGHT (BALLAST) SIDE, AND THE RED WIRE ON THE LEFT SIDE. **TUCK** CONTACT WIRES UP AGAINST BOTTOM END OF BATTERY RETAINER.

D 6. **INSTALL** POWER SUPPLY BOARD.
FOLLOW INSTRUCTIONS IN SECTION B FOR REPLACEMENT OF POWER SUPPLY BOARD. **CALIBRATE** UNIT USING CALVIN SYSTEM (CALVIN USERS MANUAL IN SECTION 6)

NOTES:_____

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E **KEYPAD ASSEMBLY**

E 1. **REMOVE** FRONT HOUSING ASSEMBLY.
FOLLOW INSTRUCTIONS IN SECTION C2 TO REMOVE FRONT HOUSING.

E 2. **REMOVE** MOTOR/PUMP ASSEMBLY.
FOLLOW INSTRUCTIONS IN SECTION C3 TO REMOVE MOTOR/PUMP ASSEMBLY.

E 3. **REMOVE** LCD MODULE SUPPORT FROM BACK HOUSING.
UNSCREW TWO SCREWS AND **LIFT** SUPPORT DOWN AND AWAY FROM LCD MODULE. **DO NOT ALLOW** THE LCD DISPLAY TO FALL OUT OF THE BACK HOUSING. **PRESS** ANY BUTTON TO LIFT KEYPAD ASSEMBLY OUT OF BACK HOUSING.

REPLACE KEYPAD ASSEMBLY

E 4. **REPLACE** KEYPAD ASSEMBLY.
INSERT REPLACEMENT KEYPAD ASSEMBLY INTO HOLES IN BACK HOUSING WITH LETTERS RIGHT SIDE 'UP'. **ALIGN** LCD RETAINER OVER LCD AND KEYPAD ASSEMBLY AND **INSERT** LATCH OF RETAINER INTO NOTCH IN TOP OF BACK HOUSING. **ALIGN** 2 ALIGNMENT PINS ON THE BACK OF THE RETAINER WITH THE TWO ALIGNMENT HOLES IN THE KEYPAD ASSEMBLY PRINTED CIRCUIT BOARD. **SECURE** RETAINER WITH TWO SCREWS.

E **KEYPAD ASSEMBLY**

E 5. **REPLACE** MOTOR/PUMP ASSEMBLY.
FOLLOW INSTRUCTIONS IN SECTION C4 THROUGH C6 FOR MOTOR/ PUMP ASSEMBLY.

E 6. **TEST** HANDLE.
PERFORM FUNCTIONAL CHECKS TO ASSURE CORRECT OPERATION OF REPLACEMENT SWITCHES.

NOTES:_____

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F **LCD ASSEMBLY**

F 1. **REMOVE** LCD RETAINER.
FOLLOW STEPS E1 THROUGH E3 TO REMOVE LCD RETAINER.

F 2. **REMOVE** LCD MODULE.
LIFT OUT LCD MODULE.

REPLACE LCD ASSEMBLY

F 3. **PLACE** LCD ASSEMBLY INTO BACK HOUSING.
REMOVE PROTECTIVE FILM FROM BEZEL. **RECORD** LCD ID# ON DOCUMENTATION. **ALIGN** LCD ASSEMBLY WITH FLEX CIRCUIT CONNECTOR ON RIGHT HAND SIDE THEN **PLACE** INTO HOUSING.

F 4. **SECURE** MODULE WITH RETAINER.
PLACE LCD MODULE RETAINER AND **PLACE** LATCH IN THE NOTCH AT THE TOP OF THE BACK HOUSING. **ALIGN** TWO PINS ON UNDERSIDE OF RETAINER WITH TWO ALIGNMENT HOLES OF KEYPAD PCB.
SECURE WITH TWO SCREWS.

F 5. **REASSEMBLE** HANDLE.
FOLLOW INSTRUCTIONS IN SECTION C 4 THROUGH C 6 AND
PERFORM FUNCTIONAL CHECKS.

END LCD ASSEMBLY REPLACEMENT

NOTES:_____

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G **ESD SHIELDS (CE MODEL)**

REMOVAL OF ESD SHIELDS (SEE FIG. G-1)

G 1. **REMOVE** POWER SUPPLY BOARD.
FOLLOW INSTRUCTIONS IN SECTION B.

G 2. **REMOVE** MOTOR PUMP ASSEMBLY.
FOLLOW INSTRUCTIONS IN SECTION C.

G 3. **REMOVE** MCU BOARD.
FOLLOW INSTRUCTIONS IN SECTION D.

G 4. **REMOVE** KEYPAD ASSEMBLY.
FOLLOW INSTRUCTIONS IN SECTION E.

G 5. **REMOVE** LCD ASSEMBLY.
FOLLOW INSTRUCTIONS IN SECTION F.

G 6. **REMOVE** ESD SHIELDS.
THE LCD GASKET AND THE ESD SHIELD ARE CONNECTED WITH TWO STRIPS OF ESD TAPE. THESE ASSEMBLED SHIELDS SHOULD PULL OUT OF THE BOTTOM HOUSING.

NOTES:_____

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REPLACEMENT OF ESD SHIELDS (CE MODEL)

G 17. **REPLACE** SHIELDS AS PER ASPEC A02727.

G 17. **REASSEMBLE** UNIT.
FOLLOW STEPS G1 THROUGH G6 IN REVERSE ORDER.

FIG. G-1 HANDLE CE LABEL

H **VALVE**

H 1. **REMOVE** VALVE FROM POWER SUPPLY BOARD.
REMOVE BATTERY COVER AND BATTERY FROM HANDLE. **REMOVE** POWER SUPPLY BOARD FROM HANDLE BY FOLLOWING STEPS IN SECTION B 1 THROUGH B 4. **UN-SOLDER** VALVE FROM FOUR CONNECTION POINTS UNDER THE POWER SUPPLY BOARD. **LIFT** VALVE FROM BOARD AND **DISCONNECT** TUBING FROM VALVE.

REPLACE VALVE

H 2. **INSTALL** REPLACEMENT VALVE.
ATTACH TUBING TO PRE-TESTED, PRE-TRIMMED REPLACEMENT VALVE. **PREPARE** BOARD FOR RE-SOLDERING BY **REMOVING** EXCESS SOLDER AND **CLEARING** BOARD HOLES TO ACCEPT REPLACEMENT VALVE. **INSERT** REPLACEMENT VALVE IN PLACE WITH THE TUBE-END TOWARDS THE BALLAST. **SOLDER** THE VALVE IN PLACE. **CLIP OFF** VALVE LEADS ABOVE SOLDER JOINTS.

H 3. **INSTALL** POWER SUPPLY BOARD INTO HANDLE.
FOLLOW STEPS B 4 THROUGH B 5 TO INSTALL POWER SUPPLY BOARD.

H 4. **CALIBRATE** HANDLE.
FOLLOW CALVIN PROCEDURE TO CALIBRATE HANDLE.

END VALVE REPLACEMENT

NOTES:_____

I **BALLAST**

I 1. **REMOVE** BALLAST FROM POWER SUPPLY BOARD.
REMOVE BATTERY COVER AND BATTERY FROM HANDLE. **GENTLY PULL** BALLAST FROM THE POWER SUPPLY BOARD. **LIFT** BALLAST FROM BOARD AND **DISCONNECT** TUBING FROM BALLAST. **REMOVE** DOUBLE SIDED TAPE FROM BOARD IF IT IS PARTIALLY TORN AWAY.

REPLACE BALLAST

I 2. **INSTALL** REPLACEMENT BALLAST.
CLEAN BOTTOM OF BALLAST WITH ALCOHOL AND **LET** DRY ONE MINUTE. **ATTACH** TUBING TO REPLACEMENT BALLAST BY FIRST **ATTACHING** TUBING FROM THE PROBE TIP TO THE TOP END OF THE BALLAST. THEN **ATTACH** TUBING FROM THE VALVE TO THE TOP SIDE-PORT OF THE BALLAST. **ATTACH** TUBING FROM THE PUMP TOP CAP TO THE LOWER SIDE PORT OF THE BALLAST. **CLEAN** MOUNTING SURFACE FOR REPLACEMENT DOUBLE SIDED FOAM TAPE. **APPLY** BROWN LAYER SIDE OF 2 SIDED TAPE TO BOTTOM OF BALLAST. **ATTACH** ADHESIVE BACKED WARNING LABEL TO SIDE OF BALLAST. **CHECK** ALL TUBING FOR SHARP BENDS, TWISTS OR LEAKS.

I 3. **CALIBRATE** HANDLE.
FOLLOW CALVIN PROCEDURE TO CALIBRATE HANDLE.

END BALLAST REPLACEMENT

J **KEYPAD**

J 1. **REMOVE** KEYPAD.
UNPLUG MICROTYMP 2 PRINTER/CHARGER FROM LINE VOLTAGE.
PEEL OLD KEYPAD FROM PRINTER/CHARGER TOP PANEL **USING** FINGERNAIL UNDER ONE CORNER.

J 2. **UNPLUG** FLEX CIRCUIT.
GENTLY **PULL** FLEX CIRCUIT FROM BACK OF KEYPAD. **REMOVE** ANY RESIDUAL ADHESIVE FROM THE PRINTER/CHARGER TOP PANEL WITH ALCOHOL. **WAIT** ONE MINUTE FOR ALCOHOL TO EVAPORATE.

REPLACE KEYPAD

J 3. **INSTALL** REPLACEMENT KEYPAD.
REMOVE ADHESIVE LINER FROM PCB. **PLUG** FLEX CIRCUIT INTO KEYPAD PCB. **DO NOT TWIST** FLEX CIRCUIT. **POSITION** KEYPAD BOTTOM EDGE WITH THE BOTTOM EDGE OF THE KEYPAD RECESS IN THE TOP PANEL. **POSITION** TWO SEMI-CIRCULAR DETENTES IN THE KEYPAD RECESS FIT INTO TWO SEMI-CIRCULAR CUTOUTS ON THE KEYPAD PCB. **FEED** THE FLEX CIRCUIT INTO THE HOLE OF THE TOP PANEL AS YOU **PLACE** THE KEYPAD AGAINST THE TOP PANEL.

J 4. **TEST** PRINTER/CHARGER.
PERFORM FULL FUNCTIONAL TESTS ON PRINTER/CHARGER. **REFER** TO SPECIFICATION A-02728 IN SECTION 12.

END PRINTER/CHARGER KEYPAD REPLACEMENT

NOTES:_____

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K **PRINTER AND/OR PCB**

NOTE: A CE MODEL PRINTER
(SEE LABEL) WILL CONTAIN MAIN PCB #711730-509. DO NOT REPLACE IT WITH A 711730-508 (NON CE BOARD). YOU CAN NOT UPGRADE A 508 BOARD TO A 509 BOARD. YOU CAN PUT A 509 INTO A UNIT IN PLACE OF A 508.

K 1. **REMOVE** PAPER.
REMOVE PAPER ACCESS COVER BY **PULLING** UP ON THE FRONT EDGE. **PULL** PAPER LEVER AND **REMOVE** PAPER ROLL AND SPINDLE.

K 2. **REMOVE** TOP PANEL FROM CASE.
REFER TO FIG. I-1 IN THIS MANUAL. **DO NOT UNSCREW** THE TWO SCREWS INDICATED ON THE DRAWING. THESE FASTEN THE PRINTED CIRCUIT BOARD TO THE LOWER HOUSING. **UNSCREW** THE SIX (6) REMAINING METAL PHILLIPS HEAD SCREWS AND ONE (1) NYLON NON-CONDUCTIVE 3/16" HEX HEAD SCREW. **USE** 3/16" NUT DRIVER. **TURN** THE PRINTER/CHARGER OVER AND GENTLY **LIFT** THE TOP PANEL OFF. **COMPARE** ROUTING AND CONNECTION OF FLEX CIRCUITS TO ASSEMBLY DRAWING. **INSPECT** FOR TEARS AT THE PLUGS. **UNPLUG** THESE TWO FLEX CIRCUITS FROM THE PCB. **REMOVE** THE TOP PANEL.

K PRINTER AND/OR PCB REPLACEMENT.

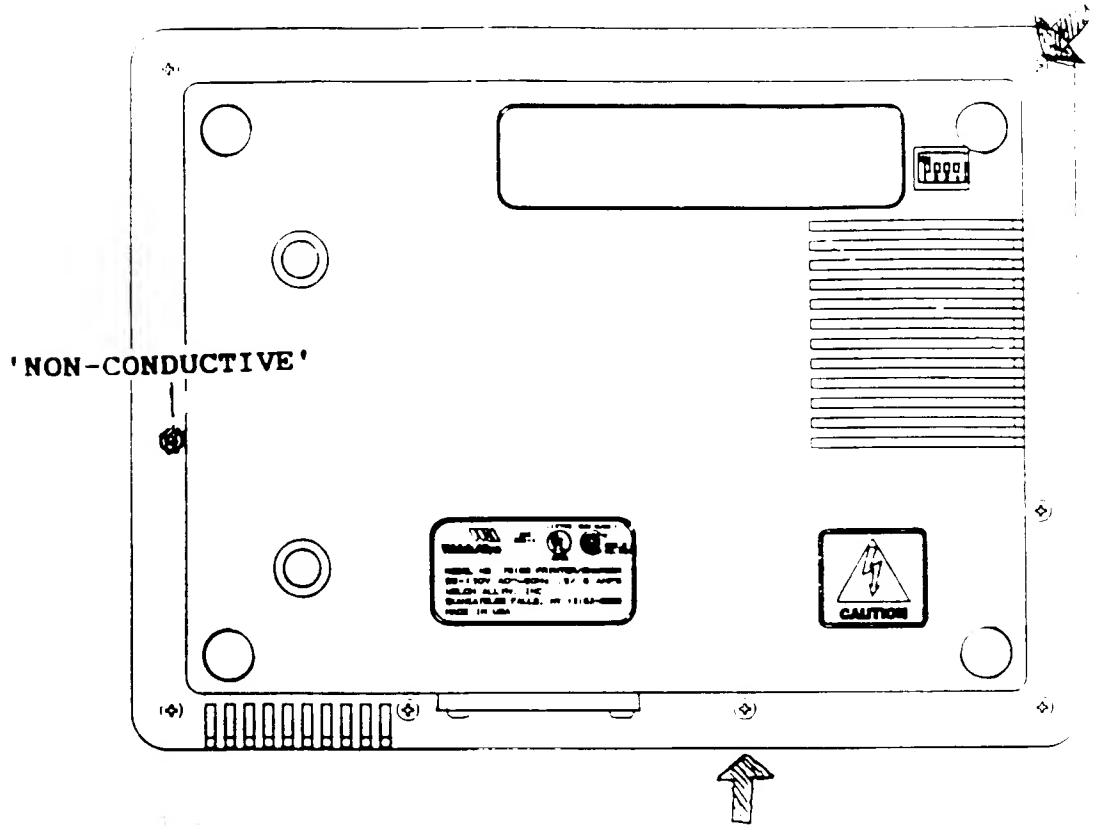

FIGURE I - 1 UNFASTENING TOP PANEL *

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Unfasten the top panel by removing all screws as shown in the figure above, except the two screws marked with arrows. These two screws hold the PCB to the lower housing. **Remove** them if the PCB is to be removed after the top panel is off.

NOTE:
USE 3/16" NYLON HEX HEAD SCREW IN LOCATION AS SHOWN IN ABOVE FIGURE. TIGHTEN UNTIL HEAD OF SCREW IS IN CONTACT WITH CASE.

K PRINTER AND/OR PCB

K 3. **REMOVE** PRINTER AND PCB FROM PRINTER/CHARGER HOUSING. **TURN** THE HOUSING ON END AND **SUPPORT** THE PCB FROM WITHIN WHILE **UNSCREWING** TWO REMAINING SCREWS AND NUTS. **LIFT** THE PRINTER/PCB ASSEMBLY PARTIALLY OUT OF THE CASE TO ALLOW YOU TO **DISCONNECT** THE THREE POWER LEADS FROM THE EMI FILTER. **BE CAREFUL NOT TO BEND** THE DIP SWITCH ASSEMBLY.

K 4. **REMOVE** PRINTER FROM PCB.
UNPLUG CONNECTOR FROM PRINTER. **PARTIALLY UNSCREW** FOUR SCREWS ONLY AS FAR AS NEEDED TO DISENGAGE THE PRINTER. **SLIDE** THE PRINTER OUT FROM UNDER THE GEAR COVER. THIS METHOD WILL KEEP THE FOUR STANDOFFS CAPTIVE ON THE SCREW THUS ELIMINATING HAVING TO REPOSITION THEM WHEN INSTALLING THE REPLACEMENT PRINTER. IF YOU REMOVE THE FOUR SCREWS ENTIRELY, THE FOUR SMALL PLASTIC STAND-OFFS WILL FALL OUT FROM UNDERNEATH THE BLACK PAPER WELL. IF THEY DO FALL OUT, **ROTATE** PAPER WELL OUT OF THE WAY AND **USE** SUPER GLUE TO HOLD STANDOFFS TO BOARD WITH 1/64" DOT OF GLUE TO THE STANDOFF. **ATTACH** STANDOFFS TO THE BOARD. **ROTATE** PAPER WELL OVER BOARD AND **ALIGN** HOLES WITH STANDOFFS.

REPLACE PRINTER

K 5. **ATTACH** REPLACEMENT PRINTER TO PAPER WELL/PCB.
SLIDE REPLACEMENT PRINTER UNDER GEAR COVER AND **ALIGN** SCREW HOLES IN PRINTER WITH HOLES IN PCB/PAPER WELL. **SECURE** PRINTER TO PCB/BOARD ASSEMBLY WITH FOUR SCREWS. **CONNECT** CIRCUIT CONNECTOR TO PRINTER.

K 6. **REPLACE** PRINTER/PCB INTO HOUSING.
POSITION THE PCB OVER THE HOUSING AND **CONNECT** THE POWER LEADS TO THE EMI FILTER. **SECURE** THE PCB TO THE CASE WITH TWO SCREWS AND NUTS AS SHOWN BY ARROWS IN FIG. I - 1.

K 7. **ATTACH** TOP PANEL TO CASE.
POSITION THE TOP PANEL OVER THE CASE AND **CONNECT** THE KEYPAD FLEX CIRCUIT TO THE PCB. **CHECK** FOR TWISTS IN FLEX CIRCUIT. **CONNECT** THE CONTACT HOUSING ASSEMBLY FLEX CIRCUIT (BLACK SIDE FACING PRINTER WELL OR PIN 1 OF FLEX TO PIN 1 ON PCB) TO THE MAIN PCB. **LOWER** THE TOP PANEL SLOWLY AND MAKE SURE CONTACT HOUSING FLEX IS AROUND STANDOFF. **REFER** TO FIG. I-1 AND **SECURE** TOP PANEL TO THE CASE WITH SIX PHILLIPS HEAD SCREWS AND ONE 3/16" HEX HEAD NYLON SCREW. **USE** 3/16" NUT DRIVER AND **SLOWLY TIGHTEN** UNTIL THE HEAD OF THE SCREW CONTACTS THE CASE.

K 8. **INSERT** PAPER AND PAPER ACCESS DOOR.
REFER TO OPERATING INSTRUCTIONS PAGES C-48 AN C-49 FOR PAPER REPLACEMENT.

K 9. **TEST** PRINTER CHARGER.
FOLLOW INSTRUCTIONS A SPEC " MANUF. INSTRUCTIONS STATION 5 TEST AND SHIP" IN SECTION 12.

SECTION 2

PRELIMINARY BENCH TEST FOR MICROTYMP 2 23641

- ***Purpose of test:*** Tests MicroTymp 2 for: 1 Leaks, 2 Vent rate, 3 Noise, 4 Recharge, 5 Inactive current drain, 6 Active current drain. These tests help prevent aborted calibration cycles in Calvin, thus saving time. The technician can resolve MT2 handle problems *before* starting the recal process.
- ***How Performed:*** Perform tests in series in numerical sequence.
- ***When Performed:*** Before recalibration.
- ***Required*** Equipment: Welch Allyn Calvin Recalibration system, Digital Volt Ohm meter, Pressure Box T-5657 or equivalent pressure source (400 dPa max, with 1 dPa resolution on digital display), fully charged battery.

Test 1 Leaks

1.1 — Open MT2 and remove battery.
1.2 — Momentarily apply 7.2 VDC across valve coil to latch valve closed. See FIG 1.2 for polarity.
1.3 — Connect Pressure Box (T-5657) pressure tube to MT2 probe tip while valve is latched closed.
1.4 — Adjust pressure of T-5657 to 200 dPa and observe leak rate. Must leak less than 10 dPa in 5 seconds.
1.5 — Throw Pressure/Vent switch to V (vent).
1.6 — Throw Select switch to Negative. (This will cause meter to read positive with negative pressure.)
1.7 — Throw Pressure/Vent switch to Pressure
1.8 — Adjust pressure of T-5657 down to -400 dPa and observe leak rate. Must leak less than 10 dPa in 5 seconds.

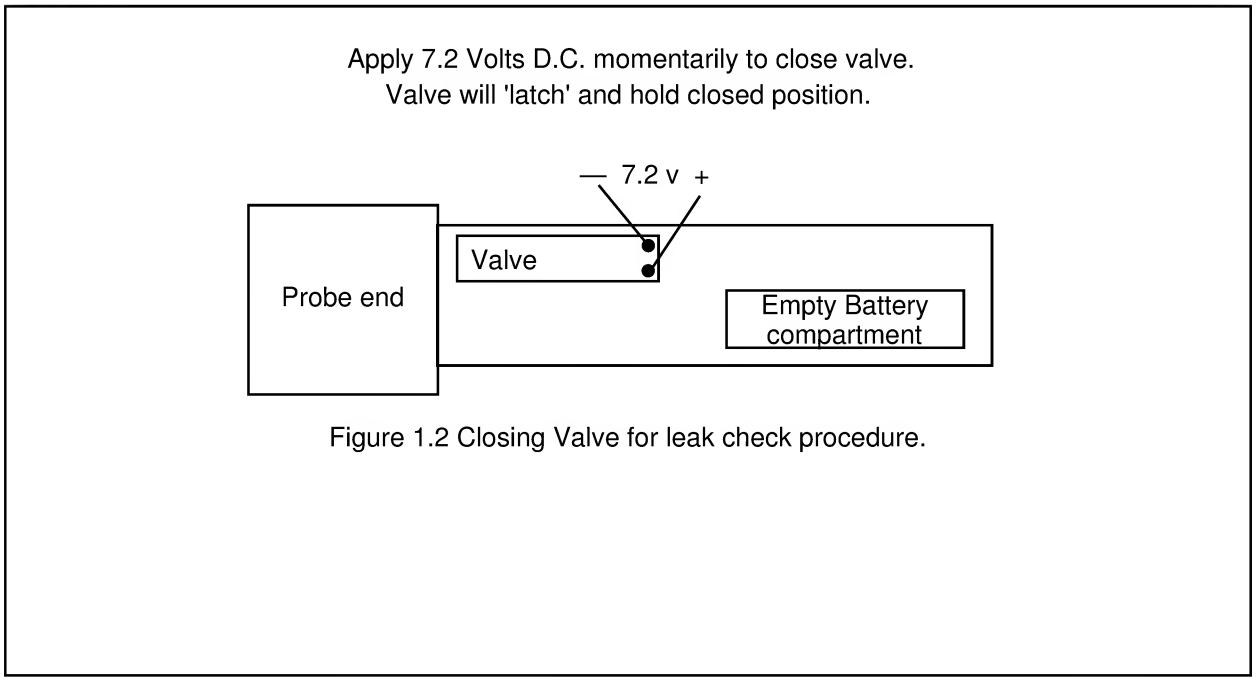

Figure 1.2 Closing Valve for leak check procedure.

Preliminary Bench Test for MicroTymp 2 23641 continued:

Test 2 Vent Rate

2.1 — Momentarily apply 7.2 VDC across valve coil (with reverse polarity) to open (unlatch) valve. See FIG 2.1 for polarity. This will vent -400 dPa from step 1.8.
2.2 — Observe pressure reading on T-5657. Pressure should vent from -400 dPa to 0 dPa in 1 second or less.

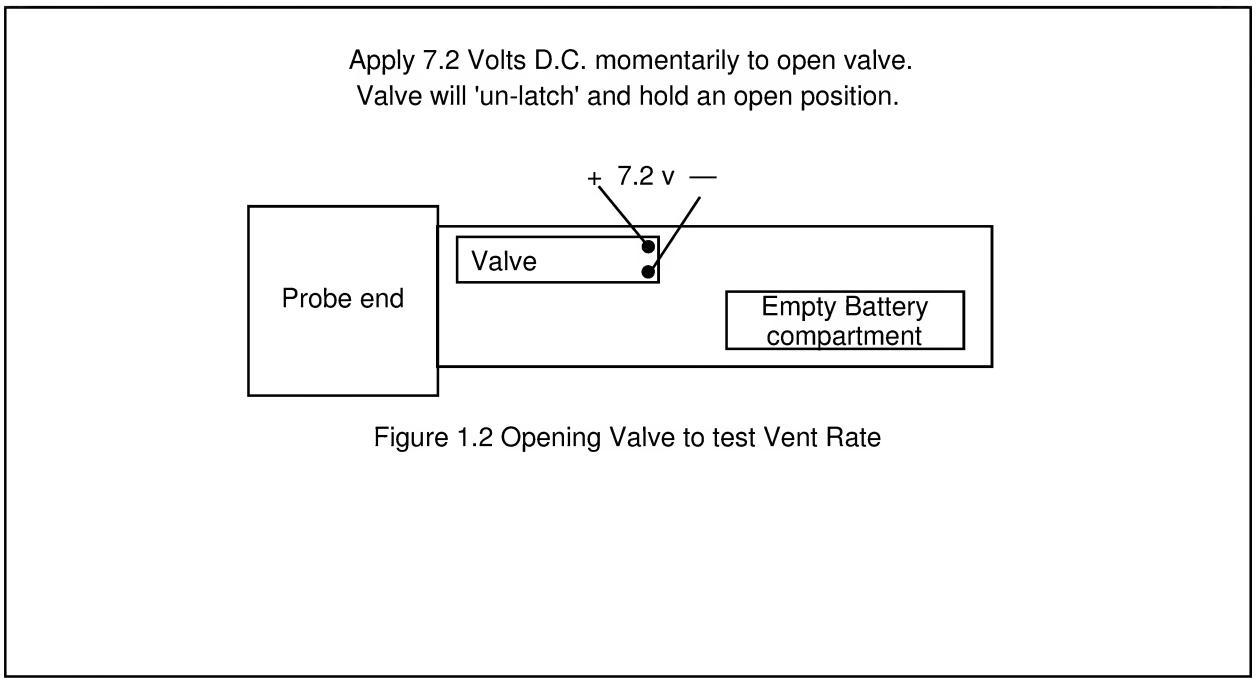

Figure 1.2 Opening Valve to test Vent Rate

Test 3 Noise

3.1 — Put **.2 cc** cavity onto the probe tip.
3.2 — Take Tympanogram of cavity by depressing and releasing black test button.
3.3 — Observe for noise. Repeat 5 times.
3.4 — Observe the number of rows above baseline. None is ideal. One row is acceptable. Two or more lines above baseline is unacceptable and constitutes a failure.
3.5 — Repeat steps 3.2 to 3.4 with 1.0 cc, 2.0 cc and 2.4 cc cavities.

Preliminary Bench Test for MicroTymp 2 23641 continued:

Test 4 Recharge

4.1 — Establish and maintain 7.2 VDC to handle charge contacts. Polarity is shown in FIG 4.1
4.2 — Snap the negative end of a fully charged battery into negative battery clips with the battery positive end tipped up at about 45 degrees. The positive spring must not touch the positive end of the battery. (only the negative end of the battery makes contact with the battery compartment negative contacts as shown in FIG 4.1 below.
4.3 — Connect Milliammeter (-) Negative lead to positive side of the battery as per FIG 4.1 below.
4.4 — Connect Milliammeter (+) Positive lead to the positive spring in the battery compartment as per FIG 4.1 below.
4.5 — Observe Ammeter reading. Current will be 60 mA +/- 5 mA.
4.6 — Remove Ammeter leads from circuit.
4.7 — Remove 7.2 volt power supply leads from handle charge contacts.
4.8 — Check resistance between the two side contacts. Value must read between 3.8 KΩ and 4.0 KΩ. If resistance is too low, check C17, C18 and C19.

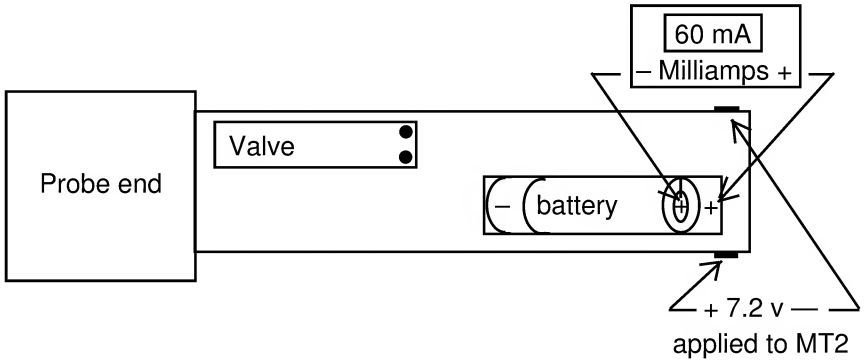

Figure 4.1 Recharge Current

Preliminary Bench Test for MicroTymp 2 23641 continued:

Test 5 Inactive Current Drain

5.1 — Keep battery in partially installed position as in step 4.2 above.
5.2 — Connect Milliammeter (-) Negative lead to positive spring contact in the battery compartment as per FIG 5.2
5.3 — Connect Milliammeter (+) Positive lead to positive side of battery . FIG 5.2
5.4 — Observe current drain. Current will be less than 1 milliamp, typically 500-600 microamps. Note: One possible cause of failure is shorted capacitor C11.
5.5 — Leave all connections as they are for the next test.

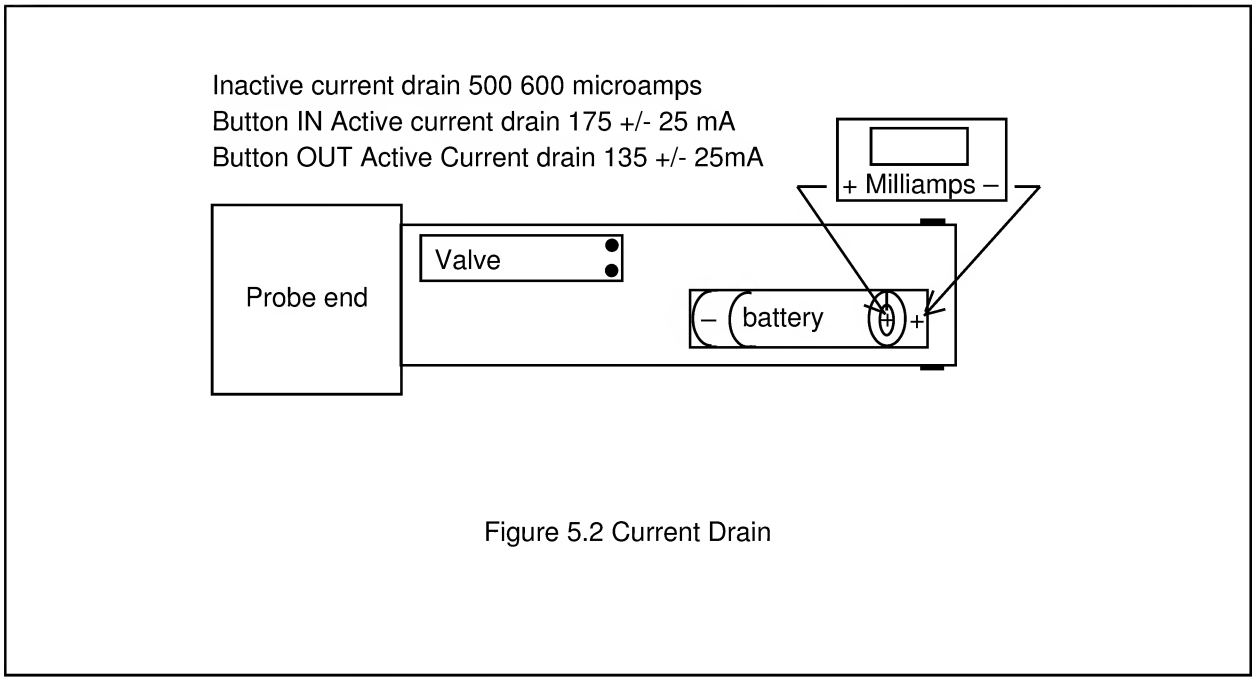

Figure 5.2 Current Drain

Test 6 Active Current Drain

6.1 — Depress and hold black center push button to activate MT2.
6.2 — Observe current drain while the black button is depressed. Current can rise up to as much as 350 mA +/- 50 mA , then fall to 175 mA +/- 25 mA..
6.3 — Release black button. Current will fall to 135 mA +/- 25 mA.
6.4 — If readings are normal, calibrate with Calvin equipment.

Preliminary Bench Test for MicroTymp 2 23641 continued:

7 Calvin Calibration for “Needs Cal”

7.1 — Select Main Menu option #2 “Calibration Tools”. ENTER
7.2 — Select Tools Menu option #1 “I2E2 Prom Editor”. ENTER
7.3 — Wait 5 seconds for CALVIN to display PROM REGISTER
Observe data in registers 2E and 2F.
2E should read FA
2F should read CE
7.4 — If data varies from above, enter correct data in by moving the cursor to register 2E and typing in FA. Do not press ‘enter’. The cursor will automatically go to position 2F. Then type in CE. Do not press ‘enter’.

Note: The entered data causes those locations to turn yellow.

7.5 — Observe registers AC, AD, AE. They should read 00 (no data)
Data may be present if unit had a “NEEDS CAL” message.
7.6 — Erase any data in these registers by moving the cursor to each register and typing in 00. Data will turn yellow. Press ENTER after AC AD and AE data is erased.
7.7 — Unit will Update registers then Tools Menu will be automatically displayed.
7.8 — Remove MT2 handle from Calvin and install fully charged battery.
7.9 — MT2 will display “OPEN” message. (working mode)
7.10 — If a “NEEDS CAL” message re-appears, there is a hard failure.
Perform troubleshooting for failed component(s).
Two common causes of “NEEDS CAL” error message are:
“Pressure Transducer Error” is caused by blocked tube(s).
Refer to section 4.5 of NEEDS CAL TROUBLESHOOTING GUIDE, found in MicroTymp2 Service Manual #236409.

“Home Pump Error” can be caused by one or combinations of : bad motor, cold solder joint, bad optical interrupt, or loose pulley. Piston is off pulley. Refer to section 3.5 of NEEDS CAL TROUBLESHOOTING GUIDE, found in MicroTymp2 Service Manual #236409.

END Preliminary Bench Test for MicroTymp 2 23641

SECTION 3

Micro Tymp 2 Noise Test Procedure

The purpose to these instructions are to give a general procedure in fixing a noisy Micro Tymp 2 handle.

1. Verify the unit by testing the unit manually with a 0.2cc, 1.0cc and 2.4cc cavity.

2. If the unit is noisy when testing manually, proceed as follows:
- **A.** Remove Battery cover.
- **B.** Examine all tubing for kinks, bends, anything to restrict air flow.
- **C.** Make sure all tubing is connected to the right place and routed per drawings.
- **E.** Test whole system for leaks. Leaks will cause noise in the system.

3. Remove screws from front housing

4. Break fiber strips from front housing.

5. Slowly remove the front housing from the back housing. While disassembling:
- **A.** Check to see if the Mic, Speaker or Pressure Transducer are touching each other or the front housing. If they are, this will cause noise in the unit.
- **B.** Check to see if the silastic tubing from the front housing to the ballast is pinched.
- **C.** See if the bottom flex is routed per drawing around the L.C.D. boss.
- **D.** See if filter tube is between the pump frame.

6. Fully open the front housing:
- **A.** Inspect the arrangement of the mic, speaker and pressure transducer.
- **B.** Check the positioning of the pump in the back housing.
- **C.** Check to see if all padding is on pump and back housing.
- **D.** Check the positioning of the pump pads and the top cap pad.

7. Correct any problems identified and reassemble the handle.

8. Check the handle for noise. If the handle is still noisy, disassemble the unit and check the handle in more depth. Reassemble the unit and recal. Do a noise check.

9. If the unit is still noisy, suspect that the pump assembly or motor is bad. Replace pump assembly and reassemble. Recal the unit and check for noise.

Troubleshooting Guide for MicroTymp2 Handles:

Problem:	Solutions:
No Tone	• Check solder connections from the speaker to the flex • Make sure speaker is seated in boot and on the SS tube • Check to see if the Speaker's SS tube in the probe tip is clogged • Flex is plugged in properly to the MCU board • Defective speaker • Defective MCU PCB
No Mic (when you put a cavity on the probe tip it does not recognize it.)	• Check solder connection from the mic to the flex • Make sure mic is seated in boot and on the SS tube • Check to see if the Mic's SS tube in the probe tip is clogged • Flex is plugged in properly to the MCU board • Defective mic • Defective MCU PCB
Handle is noisy and has 1st or 2nd pixel up in the LCD display constantly.	• Handle has a defective microphone, Replace.
Dim LCD display	• Check power supplies (±5 volts) • Defective PS PCB. • Defective LCD display, Replace
Keypad problem	• Make sure that the flex is plugged into the keypad properly • Check keypad for operation with an Ohm meter • Defective MCU or PS PCB.
Need Cal messages on the LCD Display	• Printout an I E table and look-up what the errors mean. • Follow the MicroTymp 2 "Needs Cal Error Trouble Shooting Guide" in the previous sections.
Handle does not communicate with printer/charger	• Make sure the unit is powering up • Defective PS PCB • Defective IR on the MCU PCB. Replace MCU PCB.
Handle does not charge.	• Make sure the wires are soldered good to the PS PCB and the charge contacts. • Defective PS PCB, replace • Defective MCU PCB, replace
Handle does not finish sweep on the LCD display.	• Check for leaks in the system: • Valve • Tubing • Probe tip • Pump assembly • Ballast
Noisy Handle	• Follow the instructions provided on the following page.

SECTION 4
MICRO TYMP 2 TROUBLESHOOTING
MODEL # 23641

PROBLEM	CAUSE	CORRECTIVE ACTION
Reads 'NEEDS CAL'	Error(s) in register(s)	Reset error register(s)
Does not power up	Battery low voltage	Recharge / replace battery
	Flexcable at keypad board loose	Reinsert flex cable at keypad board
	C16 shorted on PS board	Check/replace C16 on Power Supply board (PS)
	Defective Master MCU (236537-546)	Replace Master MCU
	Defective Crystal (236542-1205)	Replace crystal
	Fuse blown (F1)	Replace fuse
Unit will not take tymp (stays in 'OPEN' mode)	Broken connection at flex speaker	Repair broken connection
	Defective speaker	Replace defective speaker
	Clogged probe tip	Clean out clogged probe tip
Fading checkerboard when activated	Shorted capacitor on MCU board	Replace shorted capacitor on MCU board (.33uf)
Fails leak test – shows leak when attempting tymp	Defective valve Defective seating of probe tip component	Replace valve Reseat speaker, microphone or transducer
	Defective probe tip	Replace probe tip
	Split or frayed silicone tube(s)	Cut off frayed section of tube or replace tube
	Defective ADC (236535) (LTC)	Replace ADC (Do not use LTC type)
Causes equipment failure on Calvin testing (also causes 'NEEDS CAL' (Error Code 08 02 08)	Broken motor wire or solder joint at motor wire	Repair broken wire or solder joint at motor wire
	Cold solder joint at optical interrupt	Repair cold solder joint at optical interrupt
	Drive belt off of motor pulley	Put drive belt back on motor pulley
	Defective MCU board	Replace MCU board (236330-506)
	Misinserted Flex Cable	Reinsert Flex Cable (Top PC Board)

SECTION 4
MICRO TYMP 2 TROUBLESHOOTING
MODEL # 23641

PROBLEM	CAUSE	CORRECTIVE ACTION
Fails noise test	Defective motor	Replace motor
	Pulley set screw out of adjustment	readjust pulley set screw
Fails noise test (second pixel high or non-existent)	Defective microphone	Replace microphone
Fails sound calibration	Defective speaker	Replace speaker
	Clogged probe tip	Clean probe tip
	Defective crystal (236543-2362)	Replace crystal
	Defective MCU board	Replace MCU board
Fails motor speed	Set screw too tight	Loosen pulley set screw
	Defective drive belt	Replace drive belt
Does not recharge battery	Defective battery	Replace battery
	Black & Red wire reversed in back of Tymp handle	Restore black & red wire in back of Tymp handle
	Shorted capacitor(s) (C17, C18, C19)	Replace shorted capacitor(s)
	Defective / dirty contact	Replace / clean contact
	Defective charging regulator	Replace Power Supply board
Fails “Inactive current drain test” Ref. Sect. 2	Shorted capacitor (C11)	Replace C11 on power supply board (236340-502)
Shows EPROM check error during Calvin program test	Defective EEPROM (236532)	Replace EEPROM
Active current drain too high	Shorted capacitor (.33uf chip type)	Replace capacitor (236340-502 or 236330-506 PC board)
	Pump motor not finding home	Check pump circuit

SECTION 4

TROUBLESHOOTING GUIDE FOR 71171 MT2 PRINTER/CHARGER

PROBLEM	CAUSE	CORRECTIVE ACTION
Does not power up Fuse blown	Shorted Q1 Shorted D1 Defective C3 Defective C4	Replace Q1 Replace D1 Replace C3 Replace C4
Does not power up Fuse not blown Note: with any board that does not power up, check fuses first.	Defective U1- Voltage at U1, pins ll - 12 is too low (under 13VOC) or too high (over 17VDC) Defective D6 (shorted) Print Head Shorted	Replace U1 Replace D6 Replace Print Head
Does not feed	Poor cable connection (P302) Defective U201	Reseat cable Replace U201
Defective print	Defective Print Head Defective U201 (portions of print missing)	Replace Print Head Replace U201
Does not receive data	Poor cable connection (P301) Cold solder joint on contact housing assembly (711702-501) Defective - contact housing assembly	Reset cable Repair cold solder joint Replace contact housing assembly
Power light does not light	Cold solder joint at P302 U301 defective LED defective	Repair cold solder joint Replace U301 Replace LED
Charge light does not light	Cold solder joint at P302 Q305 defective LED defective Cold solder joint on housing assy.	Repair cold solder joint Replace Q305 Replace LED Repair cold solder joint
Charge light ON without handle in well	Defective capacitor (C309, C310, C311)	Replace defective capacitor

SECTION 5

CUSTOMER SERVICE QUESTIONS AND ANSWERS

(ALSO REFER TO OPERATING INSTRUCTIONS PN 236311)

FAILURE or COMPLAINT: FOR H A N D L E	POSSIBLE CAUSE & CORRECTIVE ACTION: FOR H A N D L E
HANDLE CODE READS "NEEDS CAL"	HANDLE HAS FAILED INTERNAL CALIBRATION TEST SEE PAGE 14, FIG. 18 OF OPERATING INSTRUCTIONS). RETURN INSTRUMENT FOR SERVICE. (WELCH ALLYN RECOMMENDS ANNUAL RECALIBRATION OF THE HANDLE). THE PRINTER CHARGER BASE DOES NOT REQUIRE CALIBRATION. A MONTHLY FUNCTIONAL CHECK USING THE MICRO TEST CAVITY IS RECOMMENDED (SEE PAGE D-51 OPERATING INSTRUCTIONS).
IMPORTANT:	THE "MICRO TEST" CAVITY PROVIDES A FUNCTIONAL TEST ONLY. **IT DOES NOT CALIBRATE AND IS NOT INTENDED TO TAKE THE PLACE OF CALIBRATION SERVICE.**
HANDLE CODE READS "LOW BATT"	THE BATTERY MAY BE DISCHARGED FROM EXTENDED STORAGE (60 DAYS) AND SIMPLY NEEDS RECHARGING. IF THE BATTERY DOES NOT RECHARGE OVERNIGHT, (APPROX. 14-16 HRS), THEN EITHER THE BATTERY IS DEFECTIVE AND SHOULD BE REPLACED, OR THE PRINTER CHARGER CHARGING CIRCUIT IS DEFECTIVE. CHECK THE PRINTER, CHARGING ABILITY BY INSERTING ANOTHER MICROTYMP HANDLE AND CHARGING IT OR INSERTING ANY MODEL AUDIOSCOPE SCREENING AUDIOMETERS FOR CHARGING. IF THE OTHER MODELS CHARGE, THEN REPLACE THE BATTERY IN THE HANDLE WITH A NEW ONE. REFER TO PAGE 12 IN OPERATING INSTRUCTIONS.
DIFFICULT TO COMPLETE A TEST. HANDLE CODE	READS "LEAK". TIPS ARE NOT INTENDED TO BE DEEPLY INSERTED INTO THE EAR CANAL. USING IMPROPER TIP SIZE CAUSES LEAKS, AND WILL MAKE IT DIFFICULT TO COMPLETE A TEST. REFER TO PAGE 5 OF OPERATING INSTRUCTIONS.

CUSTOMER SERVICE QUESTIONS AND ANSWERS

(ALSO REFER TO OPERATING INSTRUCTIONS PN 236311)

FAILURE or COMPLAINT:	POSSIBLE CAUSE & CORRECTIVE ACTION:
UNIT WILL NOT CHARGE	ONLY A MICROTYMP 2 PRINTER CHARGER WILL CHARGE THE MICROTYMP 2 HANDLE. CHECK THAT PRINTER CHARGER POWER CORD IS CONNECTED TO THE PRINTER CHARGER AND A FUNCTIONING RECEPTACLE OF PROPER VOLTAGE, FREQUENCY AND PLUG TYPE. THE GREEN 'POWER' INDICATOR WILL ILLUMINATE. SEE PAGE 4 OPERATING INSTRUCTIONS. SEE "LOW BATT" ABOVE.
PRINTER FUNCTION MESSAGES: "NO DATA REINSERT HANDLE" "NO DATA NOTHING IN MEMORY" "COMPUTER INTERFACE SWITCH#4	IS SET ON BOTTOM OF PRINTER" FOR POSSIBLE CAUSES AND SOLUTIONS FOR THESE MESSAGES, REFER TO "PRINTER FUNCTION MESSAGES" TABLE 2 ON PAGE 23 OF OPERATING INSTRUCTIONS.
PRINTER SERVICE CODES AS INDICATED BY NUMBER OF FLASHES OF GREEN "POWER" INDICATOR ON PRINTER CHARGER BASE: ONE FLASH TWO FLASHES THREE OR MORE FLASHES	FOR POSSIBLE PROBLEMS AND SOLUTIONS FOR THESE FLASHING CODES OR MESSAGES, REFER TO PRINTER/ CHARGER FLASHING INDICATORS, TABLE 3, OF OPERATING INSTRUCTIONS.

FOR ALL OTHER FAILURES,AND OR RECALIBRATION, RETURN HANDLE AND OR PRINTER CHARGER BASE TO AN AUTHORIZED SERVICE CENTER AS INDICATED ON PAGE E-55 OF OPERATING INSTRUCTIONS.

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CALVIN

MicroTymp2
Calibration System
User Manual

By: Rick Slater
February 22, 1993

Revision: A
by: RPS
date: 7/23/93

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1 Introduction

This document presents an overview of the calibration process and functionality testing performed on the MicroTymp2 handle by the calibration system. The primary purpose of the calibration system is to calibrate MicroTymp2 handles after they have been assembled. An important secondary purpose is to perform basic functionality testing of the handle to insure that each of the major components are working. These functionality tests fall into two categories. The first includes those tests that are an integral part of the calibration process. All other tests are incidental to calibration and are performed only to insure that the unit is working. These latter tests may be performed during calibration or separately.

2 Calibration Process

The MicroTymp2 handle calibration process is organized around the following steps.

- calibrate speaker gain pot
- calibrate microphone gain pot
- calibrate admittance offset pot
- calibration pressure offset pot
- calibration pressure gain pot
- motor speed table calibration

Additional functional testing is interspersed throughout these tests to take advantage of the equipment setup at the time.

- pressure leak test
- THD test
- Vea Check
- Button test
- LCD test
- Tymp Noise Test

2.1 Background Information

Each digital potentiometer has an address in the I^2E^2PROM that the handle will read and initialize the potentiometer to during power up. Calvin will determine the best settings for these pots and store the values in the proper I^2E^2PROM locations during calibration.

For brevity, I^2E^2PROM is referred to as PROM throughout this document.

22 Error Handling

When an error is detected, the operator will have the option of retrying the test or failing the unit. If the unit if failed, a reason for the failure will be displayed. Additionally, the current log file willhave additional information leading up to the failure. See the section on Log Files for more information.

It is possible that calibration equipment failures or misalignments will cause errors in the calibration. In most cases these errors will have the term 'Equipment error' in the error message. In some cases it will be difficult to differentiate between a handle failure and equipment failure; a pressure leak is a good example of this. It should be presumed that the problem is with the handle rather than the equipment, until all handles begin to show the same problem.

2.3 Calvin.res File

There is a resource file call 'CALVIN.RES' that is easily edited by any text editor. This file completely controls how Calvin is run. What tests are run, which order tests are run, what values pots need to be set to, what pressures or sound levels equipment should be set to, which ports are used to run the equipment, and much more, can all be modified with this file. This allows Calvin to easily be supported and updated without a programmer or changes to the program.

2.4 Log File

The log file is created when Calvin is started each day. Calvin names the log file with CAL as the start of the name, the month - day as the end of the name, and .LOG as the extension. As Calvin runs a test, sets a pot or encounters a problem, it writes this event to the log file with the time the event occurred. Other information is also logged; the serial number, the final pot setting with result values and total test time per unit. This log should be very helpful for troubleshooting.

2.5 Potentiometer Setting Routine

Several potentiometers (pots) are set during this calibration. All pots are digital and are set using the same method and routines. Initial start values are read from the calvin.res file. This includes the first pot value to try, the target value that we wish to obtain, and the tolerance between the target value and the obtained value that is acceptable.

During calibration, a common display screen shows the names of the pots being aligned, their current setting, the value that was last obtained with this setting, the target value that we are trying to obtain, the difference between the last two values, and the tolerance that is acceptable for that difference. When the difference is less than or equal to the tolerance, the display line of that pot turns white and the word 'SET' is placed on the line. When a pot is being adjusted, the past effect of changing the pot is used to calculate the next guess of what the pot should be set to, in order to get the target value. The term 'ADJ' is placed on the line to indicate the pot is still being adjusted.

Adjusting one pot often effects another pot. This requires rechecking and readjusting these pots until neither pot is changing and both are correctly set. If this iteration of adjusting one pot and readjusting another, goes on too many times, a failure occurs stating: 'Failure - Too many iterations'.

3 Operational Procedure

Initialization and basic functionality checks of the calibration equipment are performed when the calibration system is first booted. These checks insure that the calibration equipment is working properly. In addition, part of the operational procedure should be a step to calibrate the equipment each day, or as often as is necessary. Once everything is verified, the operator is free to pick 'calibrate handle' from the menu. The description that follows assumes the full calibration and functionality testing is enabled.

Establish Communications

After a serial number is entered, the operator is prompted to place the handle into the base. When the operator indicates that the handle is in the base, the system will attempt to establish communications with the handle. This step will verify that the handle is properly seated in the base and that the handle is alive.

Note that a communications failure can occur at any point during calibration and testing. If it does occur, the operator will be notified.

Errors:	**Corrections:**
Cannot talk to handle.	Unit not powered up, flex or micro problem

New or ReCal Prompt

A prompt appears to ask if this is a new handle that has never been calibrated, or a handle in for recalibration. The difference is that new handles will have a full initialization of the PROM with default values being loaded. Recalibration will preserve important usage count information kept in the PROM.

Get Handle Serial Number

If this is a new unit, a prompt will appear requesting the serial number. This serial number is bar coded directly on the handle. The serial number can be typed in by hand or scanned in.

Errors:	**Correction**
Invalid serial number.	Reenter serial number

Handle Self Test

This step insures that the handle microcontrollers are operating properly and all memory is functional, including ROM, RAM, and PROM. A "self test" command will be sent to the handle, which causes the RAM and ROM for both microcontrollers to be tested and the results returned. If this test passes, a "test PROM" command is sent. This causes the handle to thoroughly test I^2E^2PROM. Any errors at this stage are enough to prevent calibration. Though the slave is capable of detected additional types of errors, they are ignored since the handle is out of calibration.

Errors:	**Corrections:**
Master ROM failure.	Bad Master microcontroller
Master RAM failure.	Bad Master microcontroller
Slave ROM failure.	Bad Slave microcontroller
Slave RAM failure.	Bad Slave microcontroller
PROM failure.	Bad I^2E^2PROM

Leak Rate Test

The operator is instructed to place the pressure tube on the end of the handle tip. Pressure is set to a positive pressure and the pressure is read. After a time delay the pressure is reread and the result is subtracted from the first reading to get the leak value. Pressure is set to a negative pressure and the same test is repeated.

Errors:	**Corrections:**
Leak rate is too high.	Bad Valve, bad pump assy, leaky tip, bad ballast
Cannot talk to handle.	Bad Slave microcontroller, power unit down & restart

Calibrate Pressure Offset Pot

Pressure is set to 0 daPa. The offset pot is adjusted for a target value of 150, read at the handle pressure A/D.

Errors:	**Corrections:**
Offset pot cannot be adjusted.	Bad pot, bad Slave microcontroller
Cannot talk to handle.	Bad Slave microcontroller

Calibrate Pressure Gain Pot

Pressure is set to -400 daPa. The gain pot is adjusted for a target value of 30, read at the handle pressure A/D.

Errors:	**Corrections:**
Gain pot cannot be adjusted.	Bad pot, bad pump assy, bad Slave micro
Cannot talk to handle.	Bad Slave micro

Pressure Convergence Test

Pressure is set to 0 daPa. The offset pot is checked for a target value of 150, if the value is in spec., the pressure is set to +200daPa, and the gain pot is checked for a target value 21. If the value is in spec. the pressure system has converged. If either of the values is out of spec., the system goes back and readjusts the pressure offset and pressure gain pots.

Errors:	Corrections:
Cannot converge, too many iterations.	Bad offset or gain pot, Bad Slave micro

Calibrate Microphone

This calibration step sets the speaker so that it is able to generate an 85 dB signal in a 2cc cavity, and then calibrates the microphone gain pot (MicGain pot). The operator is prompted to connect the B&K 2231 sound meter, which is equipped with a 2cc microphone, to the handle tip. The admittance gain and admittance offset pots are set to default positions.

Errors:	Corrections:
No tone generated.	Bad speaker gain pot
Tone generated, but not at 85 dB.	Bad speaker gain or admittance gain pots
MicGain Pot cannot be adjusted.	Bad microphone gain pot

Harmonic Distortion Check

This calibration step will measure the amount of distortion present in the signal generated by the handle at 85 dB, measuring the amplitude of the signal at different harmonic frequencies.

Errors:	Corrections:
THD too large.	Bad op amps, bad D/A converter, bad A/D converter

Enter the Barometric Pressure

This step reads the barometric pressure to compensate for the difference between the days changing barometric pressures and the sea level standard we set the units to. This is done automatically in units with an automatic barometer.

Admittance Offset POT Calibration

This calibration step calibrates the admittance offset pot. The operator will be prompted to place a standard 0.5cc cavity on the handle tip. The handle will be instructed to generate an 85 dB signal by setting the admittance gain pot to the predetermined value for 0.5cc cavity. Calibration of the admittance offset pot is then attempted.

Errors:	Corrections:
Cannot adjust pot.	Bad admittance gain pot

Calibrate Speaker

This calibration step calibrates the handle speaker. The operator will be prompted to place a standard 3.0cc cavity on the handle tip. The handle will be instructed to generate an 85 dB signal by setting the admittance gain pot to the predetermined value for 3.0cc cavity. Calibration of the speaker gain pot is then attempted.

Errors:	Corrections:
Cannot adjust pot.	Bad speaker gain pot

Admittance Offset Pot and Speaker Gain Pot Convergence

This test repeats the above two tests of resetting the admittance offset and speaker gain pots until the admittance offset does not change when the speaker gain is set.

Errors:	Corrections:
Cannot converge, too many iterations.	Bad admitt offset or speaker gain pots

Volume Calibration

This calibration step provides another chance to test the speaker and microphone working together. Volume, Vea, can be determined based on knowledge of the output level of the admittance gain pot. The operator is instructed to place different size cavities on the tip of the handle. The handle is instructed to obtain a 85db level, the value of the admittance gain pot is read to determine if it matches the value it should be for the cavity set on the tip.

Errors:	Corrections:
Volume is incorrect.	Redo sound cal

Calibrate Motor Speed

This step of the calibration process is used to calibrate the motor speed table for cavity sizes of 0.2 cc through 2.5 cc. The operator is prompted for different size cavities. The handle runs pressure sweeps for each cavity, checks the time it takes to run the sweep, and adjusts the motor speed pot to get a 1500 ms sweep. A table is created for each size cavity from 0.2cc to 2.5cc.

Errors:	Corrections:
Motor speed pot cannot be adjusted.	Bad pump assy, bad motor speed pot
Cannot talk to handle.	Bad slave micro

Test LCD Elements

This test verifies that each element of the LCD display is working properly. This test verifies that each element is able to work independently of its neighbors. Four patterns are displayed for the operator to visually verify. These are: all elements off, all elements on, and two checkerboard patterns, each an inverse of the other. These four patterns will test that all elements can be on, all can be off, and that each can be either on or off independently of its neighbors.

Errors:	Corrections:
LCD element stuck on.	Bad LCD, address line short, bad flex,

LCD element out.	Bad LCD, bad flex, address line open
LCD stuck neighbors.	Bad LCD, bad flex, address line short
LCD pixels are faded.	Bad LCD, bad flex

Button Test
This will test the operability of the three buttons on the handle. The operator will be prompted to press each of the three buttons in turn. If system is unable to detect a button press, or the wrong button is pressed, an error will be reported.

Errors:	**Corrections:**
Button press not detected.	Bad button assy, open in flex
Wrong button detected.	Bad button assy, short in flex

4 Menu Options

Main Menu
Calibrate Handles This menu item leads to the standard menu calibration process. It is used for new handle calibration and old handle recalibration.
Calibration Tools This menu item is password protected. It leads to the specialized tools, which can be used to trouble shoot handles.
B&K Calibration This menu item is to allow the every day calibration of the B&K 2231 sound meter. A 124 dB piston phone is needed to do this adjustment.

Tools Menu
- I2E2PROM Editor Invokes an editor which allows the I2E2PROM contents of the handle to be interactively viewed and changed.
- RS232 Terminal Invokes the serial port terminal, which gives directed access to the handle and the sound level meter.
- Hold Handle Power On Sends a 'Disable Timer' command to the handle. This prevents the handle from turning off.
- Power Handle Down Sends a 'power down' command to the handle. This immediately shuts off the handle power.
- Calibration Menu This menu item leads to a new menu which provides commands to invoke the major calibration processes.
- Individual Tests This menu item leads to a new menu which provides commands to invoke tests to check the calibration of pressure, sound and motor sweep speed.
- Calvin Tools Menu This menu item leads to a new menu which provides commands to control the instruments connected to the PC, as well as other specialized needs.

Calibration Menu
- Pressure Subsystem Calibrates the pressure subsystem components of the handle.

- Align MicGain Pot Calibrates the microphone gain pot as part of the compliance subsystem alignment of the handle.
- Compliance Subsystem Calibrates the compliance subsystem components (speaker and admittance gain pots) of the handle.
- Motor Sweep Rate Calibrates the motor subsystem components of the handle.
- Generate Checksum Updates the I2E2PROM checksum. This is necessary after performing any of the above calibrations. Saves the I E PROM values to the PRM\ directory.
- Tymp Noise Test Runs full Tymp sweeps on different size cavities. Compliance noise is tested to ensure flat Tymps, and the Vea is checked to match the cavity.

Individual Tests Menu
- Motor Test Commands This menu item leads to a new menu which provides commands to test the motor speed of different size cavities.
- Volume Test This menu item checks the handle can correctly determine the size of different cavities.
- THD This menu item checks total harmonic distortion of the speaker in the handle.
- Leak Test This menu item checks the leak rate of different pressures in the handle.
- Button Test This menu item checks the handle can correctly read button presses.
- LCD Test This menu item checks the handle can correctly display different patterns and all pixels on the display are working correctly.

Handle Pressure Menu
- Pressure Up Sends a 'pressure up' command to the handle.
- Pressure Down Sends a 'pressure down' command to the handle and sums the pressure sweep rate table and displays the total time needed for the pressure down sweep.
- Set Cavity Size Reads the set cavity size from the handle and prompts the user to change it. Values from 0.2 to 2.5 are the only accepted response. Escape is not valid.
- Set Pressure to Handle The system requests the user place the pressure tube on the handle and then requests a pressure value. The valves in the handle and on the pressure system are closed and the syringe creates the requested pressure. Pressure range is +220daPa to -420 daPa.
- Read Pressure Sends a 'read pressure transducer' command to the handle.
- Close Valve Sends a 'close valve' command to the handle.
- Auto Zero Sends an 'open valve' and re-load pressure pots command to the handle.

Motor Test Menu
- Set Cavity Size Reads the set cavity size from the handle and prompts the user to change it. Values from 0.2 to 2.5 are the only accepted response. Escape is not valid.
- Pressure Sweep Sends a 'pressure up' command to the handle, then sends a 'pressure down' command to the handle and sums the pressure sweep rate table and displays the total time needed for the pressure down sweep.
- Auto Zero Sends an 'open valve' and re-load pressure pots command to the handle.

Handle Speaker Menu
- Speaker On Sends a 'speaker on' command to the handle.

- Speaker Off Sends a 'speaker off' command to the handle.
- Read Microphone Sends a 'read microphone' command to the handle and displays the result.

Calvin Tools Menu
- Set Pressure The system requests the user place the pressure tube on the handle and then requests a pressure value. The valves in the handle and on the pressure system are closed and the syringe creates the requested pressure. Pressure range is +220daPa to -420 daPa.
- Valve Tool Allows you to open and close the pressure relief valve.
- Read Barometer Updates barometric pressure display on top of the display.
- Handle Speaker Commands Displays menus options for turning on the handle speaker and reading the handle microphone.
- Create database Files Select the item to create empty calibration record databases.

Prom Editor

The PROM editor allows you to interactively edit the contents of PROM. The file 'promuse.msk' can be used to selectively specify which locations are automatically read. Locations which are not read in are marked with '??'. If you lose communications with the handle, a location will be marked as 'XX'. The Home key can be used to resync with the Handle.

The current cursor location is marked in white. Locations which have been changed are displayed with yellow.

Prom File Menu

This menu allows you to load default values in to PROM from a file, or to save PROM values to a file. All PROM files have the extension '.PRN'. The file must contain exactly 256 lines. A lines specifies a single memory location. Lines with -1 will be ignored and will not affect PROM.
- Read from File Use this option to load PROM memory from a file in the PRM directory. Tab to get to the list, highlight the file to be read.
- Write to File Use this option to store values from PROM to a file. Locations marked as ?? are not written to the file. All files will be written to the PRM directory; do not specify a directory. The file will have the entered filename with an extension of .PRN. Do not specify any other extension.
- Formatted dump Selecting this option will dump the contents of the editor to a file. The format is ASCII text, suitable for printing.
- Read entire PROM Use this menu item to read the entire contents of I^2E^2PROM into the editor.

Terminal

The serial terminal program is used to directly communicate with devices connected to COM1 or COM2. The following special keys are interpreted:

Alt-S Brings up a menu which lets you choose which device the terminal talks to.
Alt-H Toggles between ASCII output and Hex output.
Alt-Q Leaves the terminal program.

5 Calibration Signature

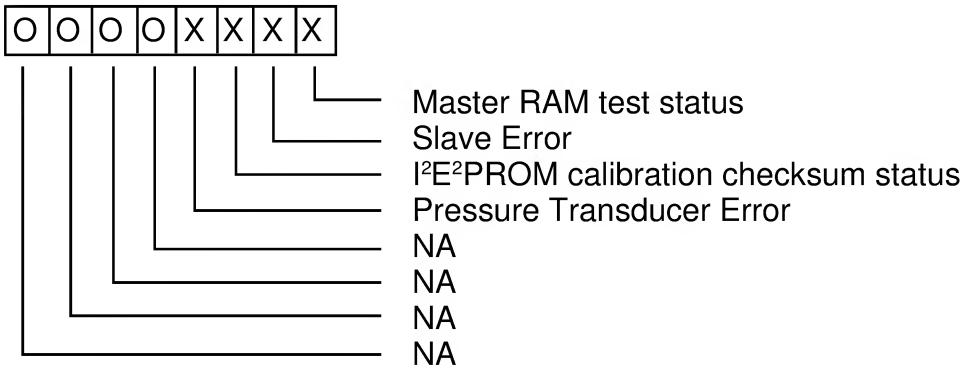
At PROM address 2E (hex) and 2F (hex), a 16 bit word describes the state of the handle. When the 16 bit word states “FACE”, the unit considers itself to be calibrated. When the unit does not say “FACE”, and it should say “DEAD”, the unit considers itself under calibration. When the unit is under calibration, it allows many faults to pass by without writing these faults to the Status Register. The calibration system writes “DEAD” to the signature addresses at the start of calibration, and when the unit is successfully calibrated, it writes “FACE”. This is done just before the checksum is calculated on addresses 00 to 2F and placed in addresses 30 & 31 (hex).

6 Status Registers

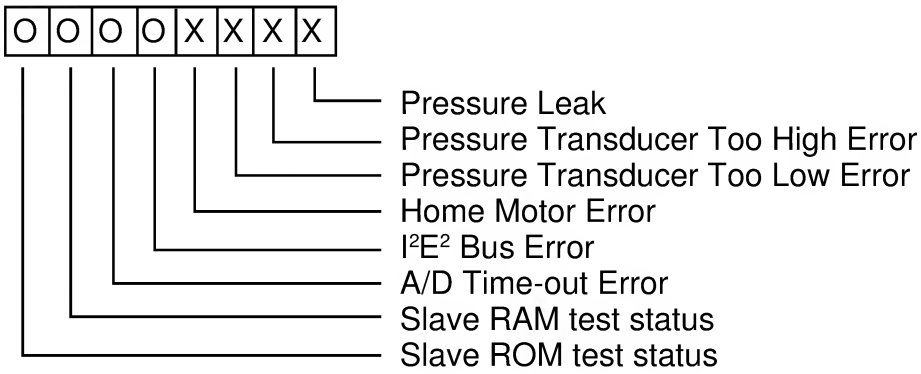
At PROM address AC, AD and AE (hex) there are three status registers. The status register at AC (hex) is a Slave processor history register. If a fatal error occurs with the Slave, a bit is set in this register. AD (hex), is the Master status register, if there is a problem with the Master, a bit is set in this register. When a fatal error bit is set in the Slave register AE (hex) the Master sets the Slave Error bit and adds the Slave Error to the Slave History Register. AE (hex) is the Slave Status Register, errors in the Slave are placed here. This register can be changed or overwritten, but a history of errors is kept in the Slave History Register.

Master Status Register (AD hex)

Failure Decode



Slave Status Register (AE hex)



7 Handle Command List

P H	Ping Handle	Establish communications
C ^A	Read I2E2PROM	Will read one byte from I2E2PROM
C ^B	Write I2E2PROM	Will write one byte to I2E2PROM
C ^C	Pressure Up	Drives pressure up to +200 daPa
C ^D	Pressure Down	Sweeps from +200 daPa to -400 daPa
C ^E	Speaker On	Begins to generate a 226 Hz signal
C ^F	Speaker Off	Turns the speaker off
C ^G	Self-test	Does self test & sends result byte
C ^H	Test I2E2PROM	Tests I2E2PROM, zeroing each location
C ^I	Read Pressure	Returns current pressure reading
C ^J	Read Microphone	Returns current value at mic A/D
C ^K	Start Tymp	Runs a Tymp
C ^L	Set LCD Pattern	Displays a pattern to the LCD (1-7)
C ^M	Close Valve	Closes the valve
C ^N	Auto Zero	Opens the valve and homes the pump
C ^O	Block Rd PROM	Sends the entire contents at once
C ^P	Block Wr PROM	Writes entire contents at once
C ^Q	Calib Mode	Disables time-outs
C ^R	Enable TimeOuts	Enables time-outs
C ^S	Read Button	Read the state of the handle buttons
C ^T	Do Compliance	Maintains compliance until ^F
C ^U	Power Down	Powers down unit
C ^W	Stop Compliance	Turn off compliance

SECTION 7

Troubleshooting Guide for MicroTymp2 Handles: 11

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1. Introduction

In trouble shooting *NEEDS CAL* messages on the MicroTymp 2 there are two registers in the EEPROM that are of interest - $AC (Historical Slave Error Register) and $AD (Historical Master Error Register). Using either the CALVIN station or a printer, obtain a printout of the contents in EEPROM. Most likely, if *NEEDS CAL* is displayed there will be a value other than $00 in either or both of these two error registers. There are some special cases that cause the unit to display *NEEDS CAL* while the contents of the two memory locations remains $00. These will be discussed later. To understand how the error are indicated in the registers you must understand the binary and hexadecimal number systems. The error codes are displayed in hexadecimal, however, the individual errors are determined by converting these "HEX" numbers to binary and then looking up the value in a table. This sounds confusing but it really isn't that bad. I will give some examples later on to illustrate my point. Below is a table that converts decimal to hex to binary numbers:

DEC	HEX	BINARY	DEC	HEX	BINARY	DEC	HEX	BINARY
0	$00	00000000	85	$55	01010101	170	$aa	10101010
1	$01	00000001	86	$56	01010110	171	$ab	10101011
2	$02	00000010	87	$57	01010111	172	$ac	10101100
3	$03	00000011	88	$58	01011000	173	$ad	10101101
4	$04	00000100	89	$59	01011001	174	$ae	10101110
5	$05	00000101	90	$5a	01011010	175	$af	10101111
6	$06	00000110	91	$5b	01011011	176	$b0	10110000
7	$07	00000111	92	$5c	01011100	177	$b1	10110001
8	$08	00001000	93	$5d	01011101	178	$b2	10110010
9	$09	00001001	94	$5e	01011110	179	$b3	10110011
10	$0a	00001010	95	$5f	01011111	180	$b4	10110100
11	$0b	00001011	96	$60	01100000	181	$b5	10110101
12	$0c	00001100	97	$61	01100001	182	$b6	10110110
13	$0d	00001101	98	$62	01100010	183	$b7	10110111
14	$0e	00001110	99	$63	01100011	184	$b8	10111000
15	$0f	00001111	100	$64	01100100	185	$b9	10111001
16	$10	00010000	101	$65	01100101	186	$ba	10111010
17	$11	00010001	102	$66	01100110	187	$bb	10111011
18	$12	00010010	103	$67	01100111	188	$bc	10111100
19	$13	00010011	104	$68	01101000	189	$bd	10111101
20	$14	00010100	105	$69	01101001	190	$be	10111110
21	$15	00010101	106	$6a	01101010	191	$bf	10111111
22	$16	00010110	107	$6b	01101011	192	$c0	11000000
23	$17	00010111	108	$6c	01101100	193	$c1	11000001
24	$18	00011000	109	$6d	01101101	194	$c2	11000010
25	$19	00011001	110	$6e	01101110	195	$c3	11000011
26	$1a	00011010	111	$6f	01101111	196	$c4	11000100
27	$1b	00011011	112	$70	01110000	197	$c5	11000101
28	$1c	00011100	113	$71	01110001	198	$c6	11000110
29	$1d	00011101	114	$72	01110010	199	$c7	11000111
30	$1e	00011110	115	$73	01110011	200	$c8	11001000
31	$1f	00011111	116	$74	01110100	201	$c9	11001001
32	$20	00100000	117	$75	01110101	202	$ca	11001010
33	$21	00100001	118	$76	01110110	203	$cb	11001011
34	$22	00100010	119	$77	01110111	204	$cc	11001100
35	$23	00100011	120	$78	01111000	205	$cd	11001101

DEC	HEX	BINARY	DEC	HEX	BINARY	DEC	HEX	BINARY
36	$24	00100100	121	$79	01111001	206	$ce	11001110
37	$25	00100101	122	$7a	01111010	207	$cf	11001111
38	$26	00100110	123	$7b	01111011	208	$d0	11010000
39	$27	00100111	124	$7c	01111100	209	$d1	11010001
40	$28	00101000	125	$7d	01111101	210	$d2	11010010
41	$29	00101001	126	$7e	01111110	211	$d3	11010011
42	$2a	00101010	127	$7f	01111111	212	$d4	11010100
43	$2b	00101011	128	$80	10000000	213	$d5	11010101
44	$2c	00101100	129	$81	10000001	214	$d6	11010110
45	$2d	00101101	130	$82	10000010	215	$d7	11010111
46	$2e	00101110	131	$83	10000011	216	$d8	11011000
47	$2f	00101111	132	$84	10000100	217	$d9	11011001
48	$30	00110000	133	$85	10000101	218	$da	11011010
49	$31	00110001	134	$86	10000110	219	$db	11011011
50	$32	00110010	135	$87	10000111	220	$dc	11011100
51	$33	00110011	136	$88	10001000	221	$dd	11011101
52	$34	00110100	137	$89	10001001	222	$de	11011110
53	$35	00110101	138	$8a	10001010	223	$df	11011111
54	$36	00110110	139	$8b	10001011	224	$e0	11100000
55	$37	00110111	140	$8c	10001100	225	$e1	11100001
56	$38	00111000	141	$8d	10001101	226	$e2	11100010
57	$39	00111001	142	$8e	10001110	227	$e3	11100011
58	$3a	00111010	143	$8f	10001111	228	$e4	11100100
59	$3b	00111011	144	$90	10010000	229	$e5	11100101
60	$3c	00111100	145	$91	10010001	230	$e6	11100110
61	$3d	00111101	146	$92	10010010	231	$e7	11100111
62	$3e	00111110	147	$93	10010011	232	$e8	11101000
63	$3f	00111111	148	$94	10010100	233	$e9	11101001
64	$40	01000000	149	$95	10010101	234	$ea	11101010
65	$41	01000001	150	$96	10010110	235	$eb	11101011
66	$42	01000010	151	$97	10010111	236	$ec	11101100
67	$43	01000011	152	$98	10011000	237	$ed	11101101
68	$44	01000100	153	$99	10011001	238	$ee	11101110
69	$45	01000101	154	$9a	10011010	239	$ef	11101111
70	$46	01000110	155	$9b	10011011	240	$f0	11110000
71	$47	01000111	156	$9c	10011100	241	$f1	11110001
72	$48	01001000	157	$9d	10011101	242	$f2	11110010
73	$49	01001001	158	$9e	10011110	243	$f3	11110011
74	$4a	01001010	159	$9f	10011111	244	$f4	11110100
75	$4b	01001011	160	$a0	10100000	245	$f5	11110101
76	$4c	01001100	161	$a1	10100001	246	$f6	11110110
77	$4d	01001101	162	$a2	10100010	247	$f7	11110111
78	$4e	01001110	163	$a3	10100011	248	$f8	11111000
79	$4f	01001111	164	$a4	10100100	249	$f9	11111001
80	$50	01010000	165	$a5	10100101	250	$fa	11111010
81	$51	01010001	166	$a6	10100110	251	$fb	11111011
82	$52	01010010	167	$a7	10100111	252	$fc	11111100
83	$53	01010011	168	$a8	10101000	253	$fd	11111101
84	$54	01010100	169	$a9	10101001	254	$fe	11111110
				255	$ff	11111111		

2. How to Determine the Error

Each error register can be assigned any one of the 256 possible hex numbers listed above. Each number represents a specific combination of errors. By converting the HEX number in the error register to its binary equivalent and using the error code tables below, you will be able to determine what errors caused the unit to display the *NEEDS CAL* message. Notice that the binary numbers actually contain eight individual numbers that are either 0 or 1. These eight numbers correspond to the eight blocks of each table. A zero for any particular block in the table means that error didn't occur. A one means an error did occur. For example, lets assume the Historical Slave Error Register ($AC) contains a $08. The first thing to do is to convert the $08 to binary. Looking up in the table we see that $08 = 00001000 in the binary column. Matching the binary digits with the Historical Slave Error Register Table, we see that the 1 is fourth from the right which corresponds to a Home Pump Error. More than one error can be indicated by either or both of the error registers. For example, assume the Historical Master Error Register contains a $0a. The binary equivalent is 00001010. Notice now that there are two digits that are set to "one". Matching this binary number with the Historical Master Error Table we see that a Pressure Transducer Error occurred and so did a Slave Error. Multiple errors are not that common. Most of the time you get a *NEEDS CAL* message you will find only one error indicated by the error registers. The N/A blocks in each table indicate that these locations aren't used for errors. If you ever determine that one of these locations contains a one, then you can assume the associated microcontroller has been damaged and no longer functions properly.

Historical Slave Error Register - $AC

ROM Error	RAM Error	A/D Timeout Error	I2C Bus Error	Home Pump Error	N/A	N/A	N/A

Historical Master Error Register - $AD

N/A	N/A	N/A	N/A	Pressure Transducer Error	EEPROM Checksum Error	Slave Error	RAM Error

Once you have determined what error was responsible for causing the *NEEDS CAL* to be displayed, you must determine why. This is done by looking up the particular error in the following section. Possible causes will be listed next to the error in addition to suggestions of areas to further investigate.

3. Historical Slave Error Register

This register indicates any error that occurred in the Slave microcontroller during operation. The Slave is responsible for the *pressure* sub-system of the MicroTymp 2. This include the operation of the *pump & motor, valve,* and *pressure transducer.* It receives commands from the Master microcontroller to perform the task such as *pressure up*, *pressure down*, *open/close valve*, *read pressure transducer*, etc. The errors that can occur in the Slave are listed below:

3.1 ROM Error - $80 / 1XXXXXXX

3.1.1 Description:

This error results from the ROM memory inside the Slave microcontroller testing bad. This memory is used to store the actual program that runs on the Slave.

3.1.2 Suggestions:

Replace the Slave microcontroller or MCU PCB, clear the error registers, power down the unit and re-test the unit.

3.2 RAM Error - $40 / X1XXXXXX

3.2.1 Description:

This error results from the RAM memory inside the Slave microcontroller testing bad. This memory is used to temporarily store program information while the Slave is operating.

3.2.2 Suggestions:

Replace the Slave microcontroller or MCU PCB, clear the error registers, power down the unit, and re-test the unit.

3.3 A/D Timeout Error - $20 / XX1XXXXX

3.3.1 Description:

There is an A/D converter inside the Slave microcontroller that is used to convert the pressure transducer value to a digital signal that can be used by the Slave in its calculations. This A/D requires a certain amount of time to initialize before it can be used properly. If for some reason it has been damaged this error will occur.

3.3.2 Suggestions:

Replace the Slave microcontroller or MCU PCB, clear the error registers, power down the unit and re-test the unit.

3.4 I2C Bus Error - $10 / XXX1XXXX

3.4.1 Description:

The I2C bus is a two wire communication link between the Slave, Master, and EEPROM. Although the Slave and Master don't talk to each other directly using

this bus, they do use it to communicate with the EEPROM. All data stored in and retrievedfrom EEPROM passes through this bus. The voltage levels on the two bus lines indicate different things to the microcontrollers. In addition, if both the Master and the Slave try to use the bus at the same time, an error could occur.

3.4.2 Suggestions:

With the unit powered up check the voltage levels of TP5 and TP6. They should be around +5V. If one of them is "stuck" at some other voltage check for broken traces or shorts involving that particular circuit. Replace MCU PCB.

Historically we have found that this error can be resolved by merely clearing the error registers, powering the unit down, and then powering it back on.

3.5 Home Pump Error - $08 / XXXX1XXX

3.5.1 Description:

An error has occurred in which the optical sensor has not detected the pump flag in the proper position after a *Home Pump* command has been attempted.

3.5.2 Suggestions:

- Verify the flex is properly seated in the connector.
- Verify that the pump and flag are functional - sometimes the pump can be stuck at one end of its travel and thus not move when the motor is actuated.
- Verify the *black* and *red* wires to the pump motor are connected properly to the flex.
- Verify there are no cracks or abrasions in the flex.
- Verify the solder connections to the optical.
- Verify that drive belt is in good condition.

3.53 N/A - $04 / XXXXX1XX

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE SLAVE OR MCU PCB.

3.6 N/A - $02 / XXXXXX1X

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE SLAVE OR MCU PCB.

3.7 N/A - $01 / XXXXXXX1

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE SLAVE OR MCU PCB.

4. Historical Master Error Register

4.1 N/A - $80 / 1XXXXXXX

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE MASTER OR MCU PCB.

4.2 N/A - $40 / X1XXXXXX

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE MASTER OR MCU PCB.

4.3 N/A - $20 / XX1XXXXX

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE MASTER OR MCU PCB.

N/A - $10 / XXX1XXXX

THIS ERROR SHOULD NOT OCCUR. IF IT DOES REPLACE THE MASTER OR MCU PCB.

4.5 Pressure Transducer Error - $08 / XXXX1XXX

4.5.1 Description:

This error occurs if the Slave consistently (100 times) reports to the Master pressure transducer values that exceed the maximum or minimum limits determined at the time of design. An error will only be registered during the *auto-zeroing* of the pressure transducer before a *pressure up* occurs.

4.5.2 Suggestions:

Test the pressure transducer section of the circuitry on the MCU PCB per the hardware specification document.

4.6 EEPROM Checksum Error - $04 / XXXXX1XX

4.6.1 Description:

This error is the result of a corrupted value in the EEPROM. Not all of the EEPROM is tested only the locations that contain calibration information. This is because these locations should never change once the unit has been calibrated. Other locations will change each time a user saves test data or actuation counters are updated.

4.6.2 Suggestions:

Clear the error registers, re-calibrate the unit, perform an EEPROM test, power down, and verify that the problem no longer exists. Replace EEPROM and/or MCU PCB.

4.7 Slave Error - $02 / XXXXXX1X

4.7.1 Description:

This error occurs only when the Slave has an error of its own that has been written to the Historical Slave Error Register.

4.7.2 Suggestions:

Verify that the Slave is working properly - Investigate the error indicated in the Historical Slave Error Register.

4.8 RAM Error - $01 / XXXXXXX1

4.8.1 Description:

This error results from the RAM memory inside the Master microcontroller testing bad. This memory is used to temporarily store program information while the Master is operating.

4.8.2 Suggestions:

Replace the Master microcontroller or MCU PCB, clear the error registers, power down the unit, and re-test the unit.

5. *NEEDS CAL* With Both Error Registers = $00

There are three error cases in which *NEEDS CAL* is displayed on the LCD screen but no error is indicated in either the Historical Master Error Register or the Historical Slave Error Register. They are as follows:

5.1 Unit Not Calibrated - $00 / 00000000

5.1.1 Description:

This error occurs when the proper calibration signature $fa $ce is not written in EEPROM locations $2e and $2f respectively.

5.1.2 Suggestions:

- Verify that $fa $ce is indeed at locations $2e and $2f
- Calibrate the unit, power down, then re-test.

5.2 Slave Communications Error - $00 / 00000000

5.2.1 Description:

This error occurs when the Slave doesn't respond to the Master's commands within a pre-defined time period.

5.2.2 Suggestions:

- Verify that the Slave and Master microcontrollers are properly installed by powering down and then powering up.
- Verify that both microcontrollers' pins all make good electrical contact to the PCB.

5.3 I2C Bus Error - $00 / 00000000

5.3.1 Description:

The I2C bus is a two wire communication link between the Slave, Master, and EEPROM. Although the Slave and Master don't talk to each other directly using this bus, they do use it to communicate with the EEPROM. All data stored in and retrieved from EEPROM passes through this bus. The voltage levels on the two bus lines indicate different things to the microcontrollers. In addition, if both the Master and the Slave try to use the bus at the same time, and error could occur.

5.3.2 Suggestions:

- With the unit powered up check the voltage levels of TP5 and TP6. They should be around +5V. If one of them is "stuck" at some other voltage check for broken traces or shorts involving that particular circuit.
- Historically we have found that this error can be resolved by merely clearing the error registers, powering the unit down, and then powering it back on.

SECTION 8

COMMERCIALLY AVAILABLE ELECTRICAL SERVICE TOOLS

1. Utica lead straightening pliers
2 Xcellite 1/8" NUT DRIVER
3. Screwdriver: Phillips #1
4. Screwdriver: Phillips #2
5. Screwdriver: 7/32" 5.5mm Flat Blade
6. Pliers, long nose: Xcelite 51CG
7. Wire cutter: Xcelite 107CG
8. Wire stripper:Xcelite 105SCG
9. Digital volt meter with leads
10. Soldering iron
11. Ground strap and ESD bench
12. Tweezers

SUPPLIES:

Item:	W/A Part #:
Loctite Black Max adhesive	M-30341
Solder, rosin core .020", 63SN/37PB	M-31446
Cotton swabs	
Desoldering wick	

Note:
The Calvin Calibration System is custom built from the items on the Lotus Spreadsheet on the next page. Some of these are custom built Welch Allyn fixtures and fittings and are so designated by a 'T' number. Other items, such as the Diaphragm Tucker and the Board to Board connector are required. T-12494 (test cavity set for calibrating the Micro Tymp 2 handle) consists of the cavities listed below:

0.2 cc	2.0 cc
0.5 cc	2.4 cc
1.0 cc	2.5 cc
1.5 cc	3.0 cc

Calibration Equipment for Micro Tymp 2

	Item Description:	Function:	Reference:
1	B&K 2231 Modular Precision Sound Level Mete	Measures sound output	Calvin Component
2	B&K 4144 1" Microphone	Sound pick-up	Calvin Component
3	B&K 1625 1/3 Octive Filter	Acoustic filter for 2231 Sound Level Meter	Calvin Component
4	B&K Z19100/WH2014 Interface Module	Connects Computer to B&K 2231 Meter	Calvin Component
5	B&K A00027 Extension Cable	Connects Meter to Microphone	Calvin Component
6	B&K ZC0020 Preamp	Input Stage to the B&K 2231	Calvin Component
7	B&K DB0375 one inch microphone adaptor	connects microphone preamp to 1"mic	Calvin Component
8	B&K DB0138 2 c.c. coupler	makes up ANSI HA-1 coupler with T-3382	Calvin Component
9	Setra 300D Readout +/- 500 dPa XXXXXX	Digital Readout of Pressure	Calvin Component
10	Clippard tubing #3814-1 (4 ft.)	Pneumatic Connections	Calvin Component
11	Clippard Solenoid valve EVO-3	Pneumatic Valving	Calvin Connection
12	Gilmont Syringe 2.5 mL #S4200	Adjustable volume	Calvin Component
13	Acopian Power Supply 6EB100	6 volt power supply	Calvin Component
14	Acopian Power Supply 24EB60	24 volt power supply	Calvin Component
15	Modified MT2 Print/Charger Base w/RS232 (W	Powers Handle and transfers data to Compute	Calvin Component
16	Kydex sound enclosure with anechoic foam	Isolates microphone from ambient noise	Calvin Component
17	Relays, transistors, switches for circuits	Electrical circuit for Calvin System	Calvin Component
18	Helical Shaft Couple DSAC 125128	Connects the motor with the Syringe	Calvin Component
19	Edmund Scientific V-Block Base A3665	Mounting of components	Calvin Component
20	Edmund Scientific Co. Holder/Base Plate A365	Mounting of components	Calvin Component
21	Edmund Scientific Co. Tilt Platform A36,607	Mounting of components	Calvin Component
22	Validyne O305A Barometric Transducer	Pressure compensation	Calvin Component
23	Compumotor S57-102 w/Indexer	Actuates syringe	Calvin Component
24	PC 386 minimum w/RS232 interface	Runs Calvin Calibration	Calvin Component
25	Calvin Software Package	Calibration Program	Calvin Component
26	Metra Byte DAS-8PGA A/D w/Dig. I/O	Air P to Digital Readout	Calvin Component
27	Setra 239 Transducer +/- .725 P.S.I.	Converts pressure to volts	Calvin Component
28	MT eartip adaptor for 2 c.c coupler (brass disc)	makes up ANSI HA-1 coupler with DB0138	T-3382
29	Battery Eliminator Electronics	Replaces Handle battery for Calvin Test	T-12224
30	Microphone Base and Extension	Holds Microphone in Sound Enclosure	T-11347
31	Electronics Base and miscellaneous hardware	Holds electronics and components	T-12168
32	Welch Allyn 8 piece Test Cavity Set for CALVIN SIZES: .2, .5, 1, 1.5, 2, 2.4, 2.5, 3		T-12494
33	Angle Bracket for B&K Sound Level Meter	Holds sound level meter in housing	T-12256
34	Pressure Sub system base	Creates pressure for testing Micro Tymp 2	T-10971
35	Diaphragm tucker	Installs pump diagram	T-5734
36	PCB Interconnect cable	Test Tool	T-13704
37	Pressure Applicator Box	Troubleshooting Leaks	T-5657
38	Loctite Black Max adhesive	Reassembly of MT2 Handle	M#30341
39	Rosin Core Solder, .020", 63jSn/37Pb	Repair	M#31446
40	ESD mat and wriststrap	Repair	commercially available
41	Electronic Technicians hand tools kit	General Repair	commercially available
42	Digital Volt Ohm Meter	Testing and repairing MT 2 handle and charge	commercially available
43	Soldering Station	Repair	commercially available

SECTION 9

BILL OF MATERIALS-REPAIR
MICRO TYMP 2 PRINTER CHARGER AND HANDLE

Welch Allyn service part numbers and material numbers appearing in this manual are for the purpose of familiarizing new technicians with the Welch Allyn parts numbering system. Order replacement parts, as always, by referencing your latest bill of materials, parts catalog and assembly drawings.

Repair Parts MT2 Handle

WHERE USED	PART NUMBER	DESCRIPTION	Ea.
23641 REPAIR	M11120	5 1/4 X 12 1/2 POLY BAG 2MIL	1
23641 REPAIR	M11385	DISPOSABLE DISPENS1NG TIP	0
23641 REPAIR	M11478	PARTS LABEL	0
23641 REPAIR	M30341	BLACK MAX	0
23641 REPAIR	M30399	LOCTITE 712 ACCELERATOR	0
23641 REPAIR	106100-1	PHPS 2-56 X.250	2
23641 REPAIR	106100-17	PHPS 2-56 X.312	2
23641 REPAIR	106100-23	PHPS 2-56 X.125	2
23641 REPAIR	236081	#2-56 PHP FL HD MACH SCREW	1
23641 REPAIR	236181	LARGE TIP	1
23641 REPAIR	236302-501	BATTERY COVER ASSY	1
23641 REPAIR	236305-502	BACK HOUSING ASSY	1
23641 REPAIR	236308-501	PUMP & BOARD ASSY	1
23641 REPAIR	236320-1	LABEL, HANDLE REFERENCE	1
23641 REPAIR	236409	MICROTYMP 2 SERVICE MANUAL	1
23641 REPAIR	236548-334	CAP,.33UF,20%,1206,Z5U,50V,TR	1
23641 REPAIR	236561-2R5	FUSE,2.5A,FAST BLOW,2817,SMD,T	1
23641 REPAIR	236080-1	LOGO LABEL	1
23641 REPAIR	236340-502	POWER SUPPLY	1
23641 REPAIR	236248	PROBE TIP	1
23641 REPAIR	106104-16	DRIVE BELT	1
23641 REPAIR	236330-506	MCU BOARD	1
23641 REPAIR	230035-2	SPEAKER	1
23641 REPAIR	236045	MICROPHONE	1
23641 REPAIR	236303-502	LCD DISPLAY	1
23641 REPAIR	236171-5	VALVE	1
23641 REPAIR	236136-504	PUMP ASSY	1
23641 REPAIR	236532	IC EE PROM	1
23641 REPAIR	236535	IC A/D CONVERTER	1
23641 REPAIR	23637-546	IC MCU 44 PIN	1
23641 REPAIR	236542-1205	CRYSTAL 12 MEG Hz	1
23641 REPAIR	236543-2262	CRYSTAL 22 .6 K Hz	1
23641 REPAIR	236541-4004	CRYSTAL 4 MEG Hz	1
23641 REPAIR	236320-2	LABEL, HANDLE RET CE	1
23641 REPAIR	236360-502	PUSH BUTTON ASSY HANDLE	1
23641 REPAIR	236401	FLEX CURCUIT BOTTOM	1
23641 REPAIR	236400	FLEX CIRCUIT TOP	1
23641 REPAIR	236001-502	BACK HOUSING	1
23641 REPAIR	729002-501	BATTERY ASSY	1
23641 REPAIR	236408-3	SHIELD, LAMINATE CE	1
23641 REPAIR	236254	CONNECTOR	1
23641 REPAIR	236259	CONNECTOR	1
23641 REPAIR	236380-2	SILICONE TUBE	1
23641 REPAIR	236382	TRANSDUCER	1
23641 REPAIR	236051	#2 PAN HEAD SCREW	1
23641 REPAIR	236063-3	OPTICAL INTERRUPT	1
23641 REPAIR	236037-1	LDC LABEL	1
23641 REPAIR	236406-1	SHIELD, INK COATED CE	1
23641 REPAIR	236425-1	TAPE ESD CE	1

MT 2 Printer Charger Repair Parts

Where used	Part Number	Description	Ea.
71171 REPAIR	M11249	POLY BAG 11 x 14 x 1 1/2	1
71171 REPAIR	M11478	PARTS LABEL	0
71171 REPAIR	106100-4	PHPS 4-40 x .38 LG	6
71171 REPAIR	106131-2	4-40 x .38 NYLON HEX	1
71171 REPAIR	236409	MICROTYMP 2 SERVICE MANUAL	1
71171 REPAIR	711702-501	CONTACT HOUSING ASSY	1
71171 REPAIR	711704-501	PRINTER KEYBOARD/LED'S ASSY	1
71171 REPAIR	711705-501	PRINTER/CHARGER BASE ASSY	1
71171 REPAIR	711755	BUMPER, CHARGING WELL	2
71171 REPAIR	711761-501	JUMPER WIRE ASSY GREEN/YELLO	1
71171 REPAIR	711762-501	JUMPER WIRE ASSY BLUE	1
71171 REPAIR	711764-501	JUMPER WIRE ASSY BROWN	1
71171 REPAIR	711805-474	CAP, 0.47UF, 20%, 1210, Z5U, 50V, TR	1
71171 REPAIR	711822-3R0*	FUSE, 3A, FAST BLOW, SMD, 250V, TR	2
71171 REPAIR	761013-501	PRINTER COVER & CUTTER ASSY	1
71171 REPAIR	761050-1	SPINDLE, PAPER ROLL	1
71171 REPAIR	761076-0	POWER CORD, DETACH. (DOM/JAP	1
71171 REPAIR	761117	THERMAL PAPER	1
71171 REPAIR	711730-509	PRINTER CHARGER PCB	1
71171 REPAIR	711758-503	TOP PANEL W/STANDOFFS	1
71171 REPAIR	711822-5R0	FUSE, 5A, FAST BLOW FOR F1 & F2 OF CE UNITS	2
71171 REPAIR	747117-2	TRIM STRIP	1
71171 REPAIR	711724-3	LABEL (CE)	1
71171 REPAIR	711815	BRIDGE RECTIFIER	1
71171 REPAIR	711818	DIODE, 3A, 50V	1
71171 REPAIR	711829	TRANS, NFET	1
71171 REPAIR	711840	IC, CURRENT MODE	1
71171 REPAIR	711842	IC, 25V REFERENCE	1
71171 REPAIR	711845-522	IC, MCU, 28 PIN	1
71171 REPAIR	711847-544	IC, MCU, 44 PIN	1
71171 REPAIR	711848	IC, 74HC, 4053	1
71171 REPAIR	761011-2	PRINTER BASE	1
71171 REPAIR	761085-1	PRINTER HEAD	1
71171 REPAIR	761135	GROUNDING PLATE	1
71171 REPAIR	236656-275	MOV, 225 VAC	1

* NOTE: This fuse for –508 and earlier PCB only.

MT2 DRAWINGS

NOS: 236300
236302
236304
236305
236308
236330
236340
711700
MICRO TYMP 2 HARDWARE BLOCK DIAGRAM

236300 | E

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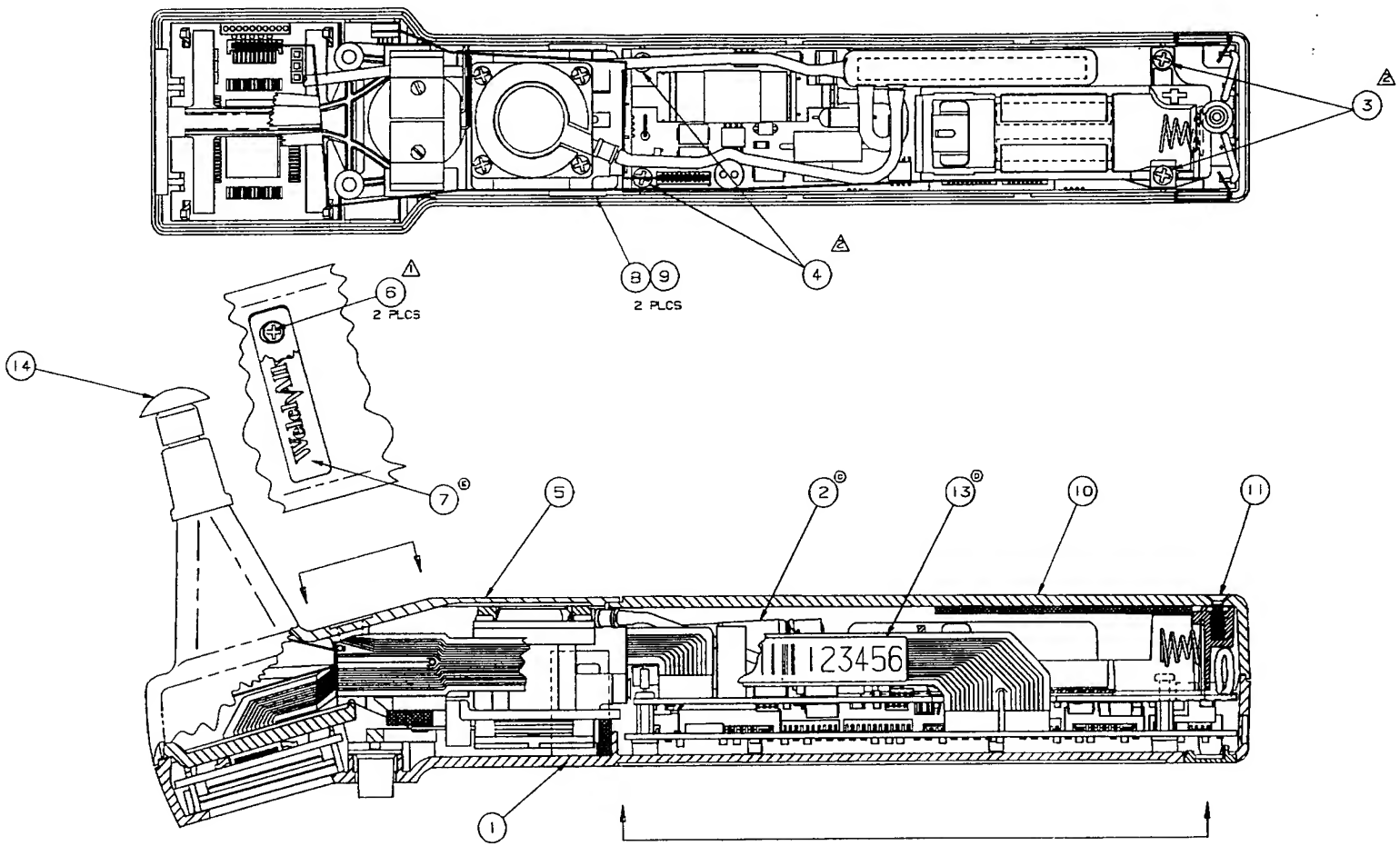
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD ENG (XF+)	E-25776	SB	2-18-93	PAG
B	REPLACED ITEM 2 SUB-ASS'Y	E-25840	SB	2-25-93	PAG
C	REPL'D ITEM 2 SUB-ASS'Y	E-25887	SB	4-5-93	JRH
D	REPL'D ITEM 13, ADD NOTE 3	E-25940	SB	9-14-93	JRH
E	UPDATED ITEMS 7 & 12	E-23887	SB	9-23-98	



NOTES:

1. ITEM 6 TO BE TIGHTENED TO A TORQUE OF 2.0 - 2.5 IN LB.
2. ITEMS 3 AND 4 TO BE TIGHTENED TO A TORQUE OF 1.5 - 2.0 IN LB.
3. APPLY ADDITIONAL BAR CODE LABELS (ITEM 13) PER MANUFACTURING INSTRUCTIONS.

MATERIAL: ~	23641	MICROTYMP II HANDLE ASSEMBLY	
	MODEL NO.	DESCRIPTION	
FINISH: ~	DRAWN: S BUERKLE 11-2-92	Welch Allyn, SKANEATELES FALLS, NEW YORK U.S.A.	
	DESIGNED:	TITLE: MICROTYMP II HANDLE ASSEMBLY	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING. TOLERANCES: .XX = ± .02 ANGLES: ±1/2° .XXX = ± .005 TOLERANCES PER ANSI Y14.5 REMOVE BURRS & SHARP EDGES EXTERNAL THDS = CLASS - 2A INTERNAL THDS = CLASS - 2B	CHECKED: DLB 11-12-92		
	APPROVED: PAG 2-18-93	CODE IDENT 94275: D	DRAWING NO. 236300 REV E
	REL TO PROD: ROS 2-17-93	SCALE: 2:1 DO NOT SCALE	SHEET 1 OF 1

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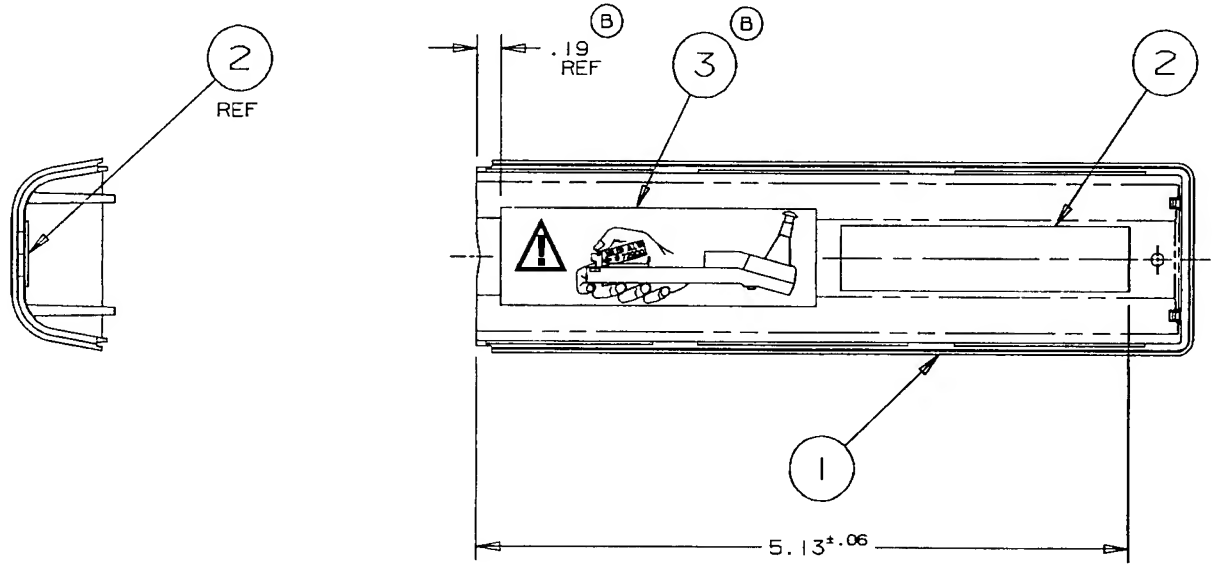
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD ENG (XF)	5-25474	SB	12-28-92	PAG
B	REPL'D ITEM 3 & LOC'N DIM	5-26922	SB	8-9-93	JRH

JAN 14 1995



NOTES:

1. CLEAN CONTACT SURFACE OF ITEM 1 WITH 70% ISOPROPYL ALCOHOL BEFORE APPLICATION OF ITEMS 2 & 3. CENTER THESE ITEMS AS SHOWN, WITHOUT WRINKLES OR FOLDS AFTER APPLICATION.

MATERIAL: -------

FINISH: -------

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
-TOLERANCES-
.XX = ±.02 ANGLES: ±1/2°
.XXX = ±.005
TOLERANCES PER ANSI Y14.5
REMOVE BURRS & SHARP EDGES
EXTERNAL THDS = CLASS - 2A
INTERNAL THDS = CLASS - 2B

THIS DWG -501		BATTERY COVER ASSEMBLY			
PART NO.		DESCRIPTION			
DRAWN DLB	DATE 8-31-92	Welch Allyn SKANEATELES FALLS, NEW YORK U.S.A.			
DESIGNED -------		TITLE: BATTERY COVER ASSEMBLY			
CHECKED SB	12-2-92				
APPROVED PAG	12-4-92	CODE IDENT 64475	B	DRAWING NO. 236302	REV B
REL TO PROD		SCALE FULL	DO NOT SCALE	SHEET 1 OF 1	

B 236302 B

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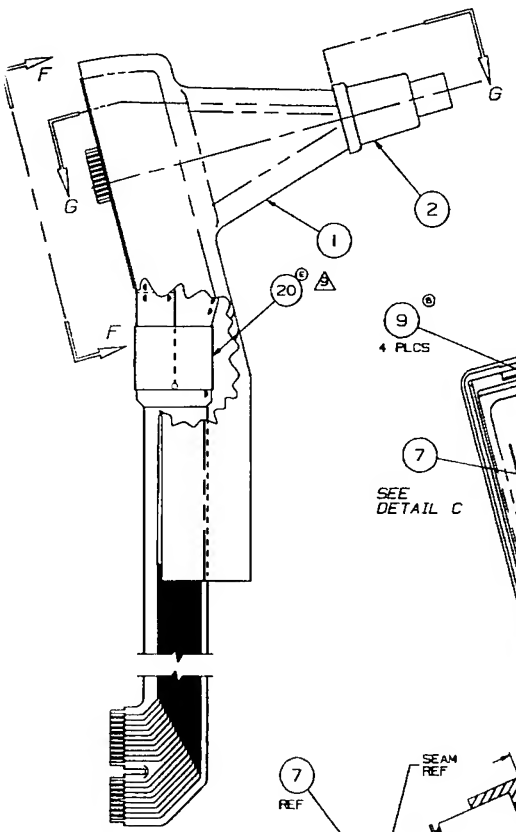
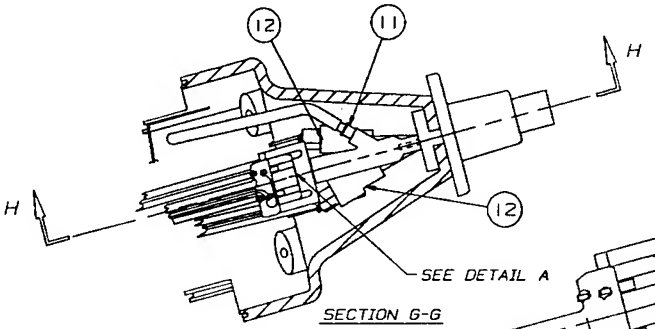
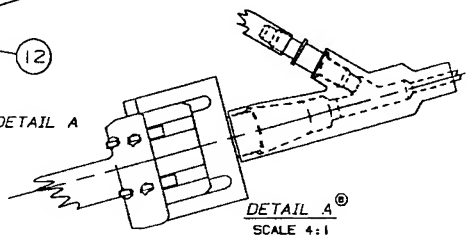
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD (CJH)	25982	SB	12-28-92	PAG
B	REM'D ITEM 17, REV'D DETAIL B, REM'D "FLUSH TO .000 FROM DETAIL A, REV'D DETAIL A SECT G-G, REPL'D ITEM 10	26740	SB	2-18-93	PAG
C	REV NOTES 2 & 4, ADD 5,6 & 7, 2.000 WAS 2.500, .63 WAS .43	27287	SB	10-6-93	JRH
D	REV ITEM 10 (BOOT) 3 VIEWS, ADD NOTE 8	27697	SB	1-28-94	JRH
E	ADDED NOTE 9 & ITEM 20	28239	SB	4-6-94	JRH

JUN 14 1995

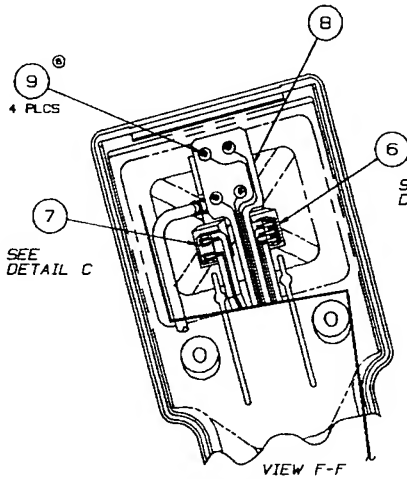


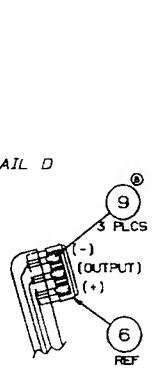


SECTION G-G

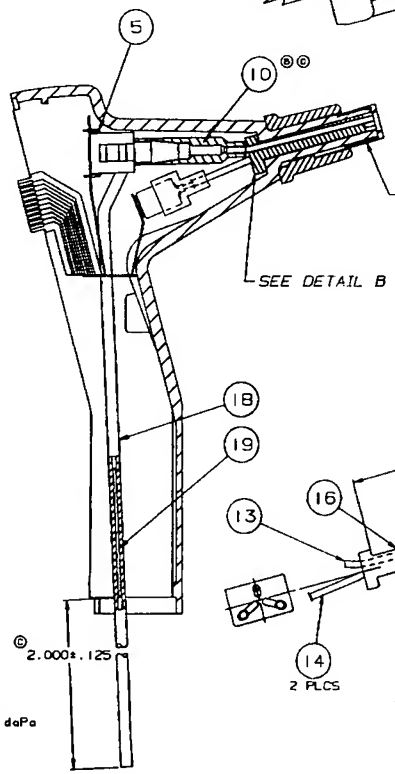


DETAIL A ⑧
SCALE 4:1

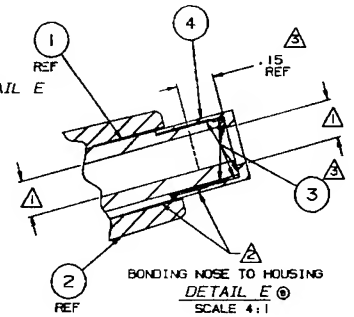




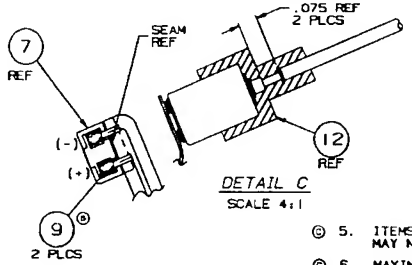
DETAIL D
SCALE 2:1



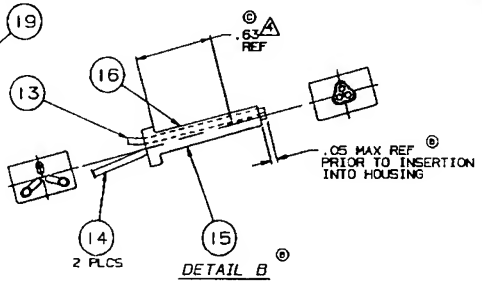
SECTION H-H



DETAIL E ⑧
SCALE 4:1



DETAIL C
SCALE 4:1



DETAIL B ⑧

NOTES:

⚠1 THESE PASSAGES MAY NOT BE RESTRICTED NOR DECREASED IN ANY WAY AFTER ASSEMBLY.

⚠2 AFTER ASSEMBLY ITEM 2 MUST TRAVEL FREELY OVER ITEMS 1 AND 4.

ⓒ ⚠3 PRIOR TO ASSEMBLY OF ITEM 4 TO ITEM 1; APPLY ITEM 3 TO REFERENCE DIMENSION SHOWN, AND DISTRIBUTE EQUALLY AROUND THE CIRCUMFERENCE.

ⓒ ⚠4 APPLY ITEM 16 WITHIN REFERENCE DIMENSIONS INDICATED, BEFORE INSERTING INTO ITEM 1. APPLY IN CIRCLES AROUND THE CIRCUMFERENCE AND IN THE THREE GROOVES OF ITEM 15.

ⓒ 5. ITEMS 5 & 10, 6 & 12, 7 & 12, AND 1 MAY NOT TOUCH EACH OTHER AFTER ASSEMBLY.

ⓒ 6. MAXIMUM LEAK RATE AT A PRESSURE OF ±400 daPa TO BE 10 daPa/S SEC.

ⓒ 7. NO SOLDER BRIDGING OR SOLDER VOIDS PERMITTED ON ITEMS 6 & 7.

Ⓓ 8. MAXIMUM SOLDERING TEMPERATURE FOR ITEMS 5, 6 AND 7, IS 600°F (315°C), WITH DURATION OF 10 SECONDS MAXIMUM.

Ⓔ 9. APPLY ITEM 20, 1 1/2" - 2" LONG PIECE OF TRANSPARENT TAPE (3M/SCOTCH MAGIC #810 OR EQUIVALENT) 1/2" - 3/4" WIDE TO ITEM 8 AT SPLIT AS SHOWN TO AID ASSEMBLY.

MATERIAL: ~	THIS DWG-501	FRONT HOUSING ASSEMBLY	
	PART NO.	DESCRIPTION	
FINISH: ~	DRAWN DLB 4/21/92	Welch Allyn	
	DESIGNED DLB 5/12/92	TITLE: FRONT HOUSING ASSEMBLY	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING TOLERANCES: .XX = ±.02 ANGLES: ±1/2° .XXX = ±.005 TOLERANCES PER ANSI Y14.5 REMOVE BURRS & SHARP EDGES EXTERNAL THDS = CLASS - 2A INTERNAL THDS = CLASS - 2B	CHECKED BFH 4/30/92		
	APPROVED PAB 12-30-92	CODE IDENT 84478 D	DRAWING NO. 236304 REV E
	REL TO PROD TB 12-30-92	SCALE 2:1 DO NOT SCALE	SHEET 1 OF 1

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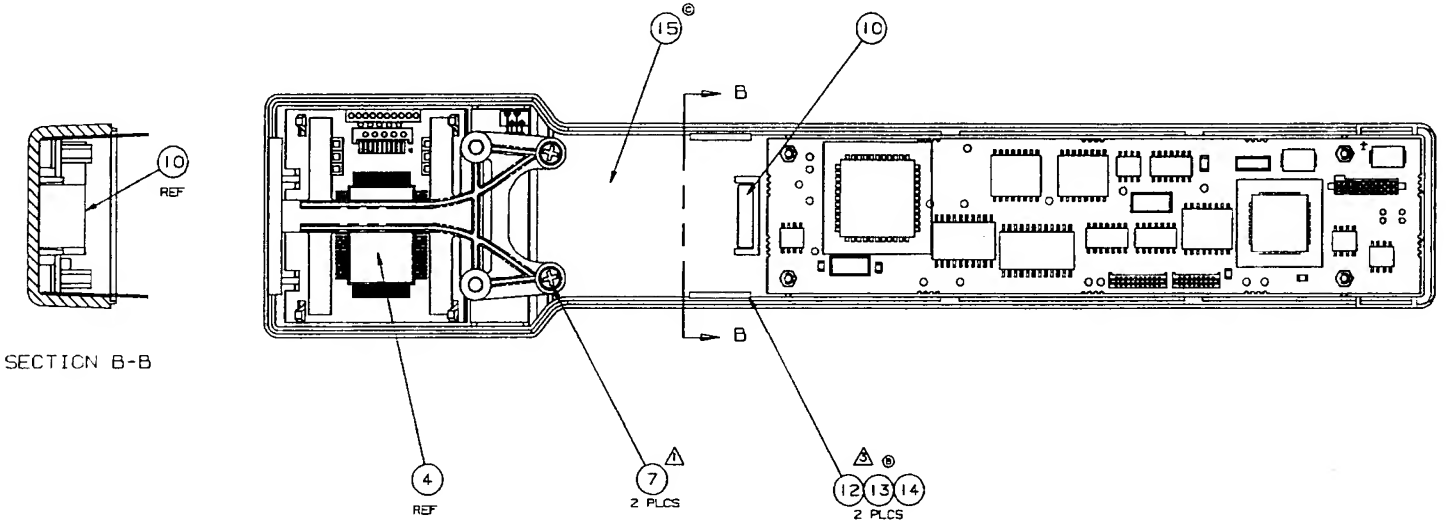
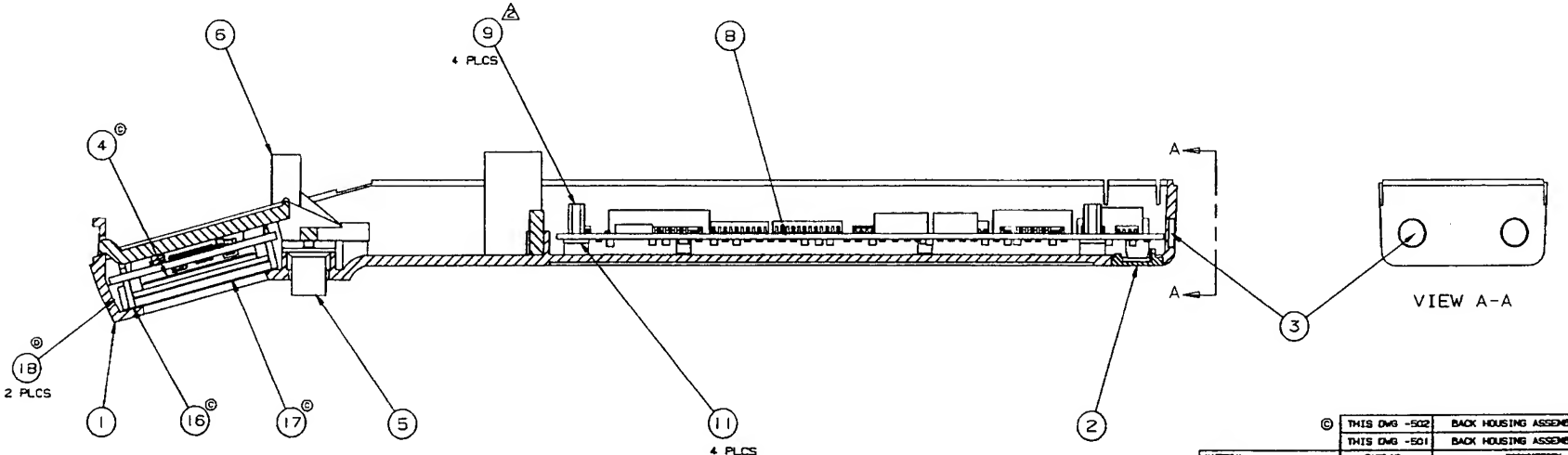
REV.	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD ENG (XX)	28432	SB	12-15-92	PAG
B	NOTE 2 WAS 2 TO 2.5 ADDED ITEMS 12, 13 & 14 2 PLCS & NOTE 3	28780	SB	2-16-93	PAG
C	ADDED-502 & ITEMS #8, #5 & #7	29112A	SB	3-17-94	JRH
D	ADDED ITEM #8 ESD TAPE	29967	SB	9-29-94	





NOTE:

1. ⚠1 ITEM 7 TO BE TIGHTENED TO A TORQUE OF 2.5 - 3.0 IN LB.
2. Ⓑ ⚠2 ITEM 9 TO BE TIGHTENED TO A TORQUE OF 1.5 - 2.0 IN LB.
3. Ⓑ ⚠3 USING ITEM 13 & 14, BOND ITEM 12 TO THE SIDE WALLS OF HOUSING AT LOCATIONS SHOWN.

©	PART NO.	DESCRIPTION
	THIS DWG -502	BACK HOUSING ASSEMBLY
	THIS DWG -501	BACK HOUSING ASSEMBLY

MATERIAL:	~
FINISH:	~
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING - TOLERANCES - .XX = ± .02 ANGLES: ±1/2° .XXX = ± .005 TOLERANCES PER ANSI Y14.5 REMOVE BURRS & SHARP EDGES EXTERNAL THDS = CLASS - 2A INTERNAL THDS = CLASS - 2B	

DRAWN	S BUERKLE	DATE 11-23-92
DESIGNED		
CHECKED	DLB	12-2-92
APPROVED	PAG	12-7-92
REL TO PROD	RDS	12-7-92

Welch Allyn SKANEATELES FALLS, NEW YORK, U.S.A.

TITLE: BACK HOUSING ASSEMBLY

CODE IDENT 64425 | SIZE D | DRAWING NO. 236305 | REV D

SCALE 2 : 1 | DO NOT SCALE | SHEET 1 OF 1

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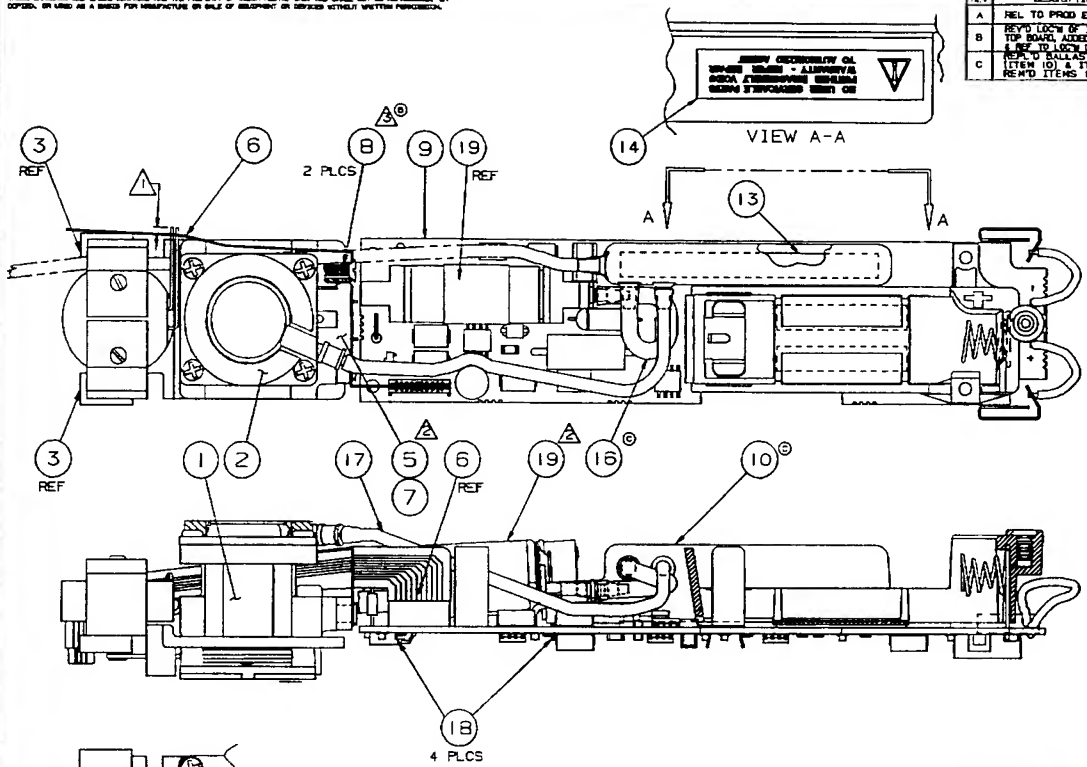
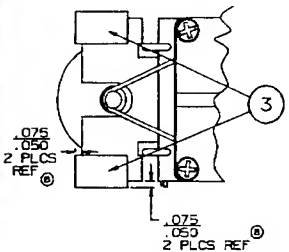
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD ENG (KH)	25430	SB	12-15-92	PAB
B	REV'D LOCTN OF ITEM 5, REV'D TOP BOARD, ADDED NOTE 3 & REF TO LOCTN OF ITEM 3	25940	SB	2-25-93	PAB
C	REL'D BALLAST ASS'Y (ITEM 10) & ITEM 16, 17 REM'D ITEMS 11, 12, 15	26057	SB	4-5-93	JRH

JUL 14 1995





NOTES:

1. TRIM WIRES TO .050 MAX FROM ITEM 6.
2. TRIM LEADS TO .050 MAX, 2 PLCS. FROM ITEM 5 AND ITEM 19.
3. ITEM 8 TO BE TIGHTENED TO A TORQUE OF 7 TO 9 IN OZ.

THIS DWG-501		PUMP & BOARD ASSEMBLY	
MATERIAL: ~	PART NUMBER	DESCRIPTION	
FINISH: ~	DRAWN S BUERKLE 12-2-92	Welch Allyn SKANEATELES FALLS, NEW YORK U.S.A.	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING -TOLERANCES- .XX = ±.02 ANGLES= 0 1/2° .XXX = ±.005 TOLERANCES PER ANSI Y14.5 REMOVE BURRS & SHARP EDGES EXTERNAL THDS = CLASS - 2A INTERNAL THDS = CLASS - 2B	DESIGNED J HERRMANN 10-3-92	TITLE: PUMP & BOARD ASSEMBLY	
	CHECKED DLS 12-3-92		
	APPROVED PAB 12-14-92	CODE IDENT 84472 C	DRAWING NO. 23630B REV C
	REL TO PROD RDS 12-15-92	SCALE 2 : 1 DO NOT SCALE	SHEET 1 OF 1

C 23630B C

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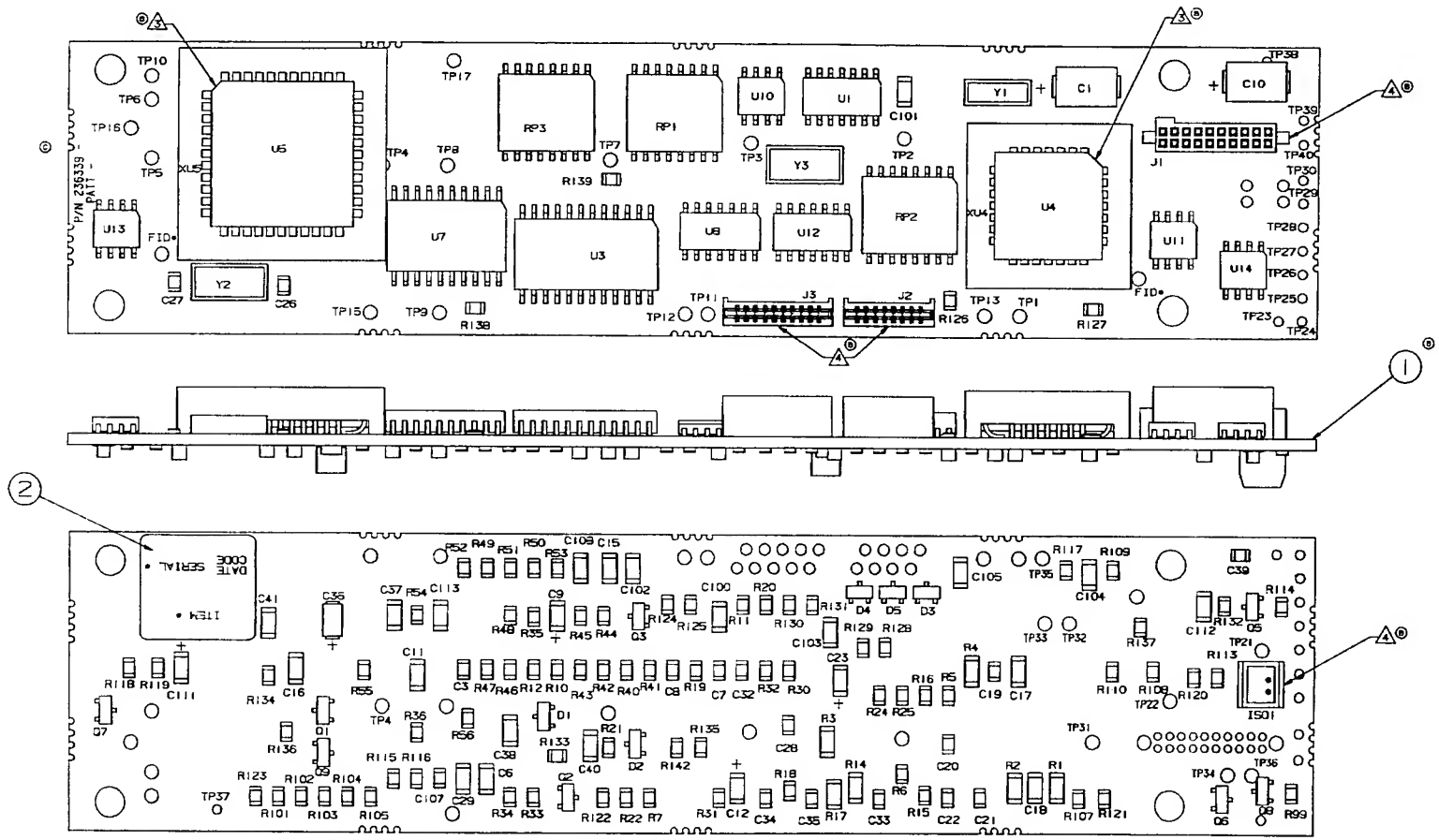
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD ENG (XE+)	E-[illegible]	SB	1-4-93	JRH
B	UPDATE COMPONENT PLACEMENT, ADD NOTES 3-5	E-[illegible]	SB	5-21-93	JRH
C	REV ASSY P/N TO -502 FOR SM REV, REM -502 P/N, ADD NOTES 8-10, PCB P/N	E-[illegible]	SB	6-28-93	JRH
D	ADDED -505	E-[illegible]	SB	8-8-93	JRH
E	REVISE COMPNT DESIGNATORS NOTE 7 & 10, ADDED -506	E-27287	SB	10-6-93	JRH
F	REVISED DUPLICATE R46, ADD R49 DESIGNATOR	E-29124	SB	3-17-94	JRH

JUL 14 1995



NOTES:

1. BREAKOUT TABS TO BE FLUSH TO BELOW EDGE OF BOARD.
2. SEE B.O.M. FOR POPULATION. "TP" SPECIFIES TEST POINT ONLY. "FID" SPECIFIES FIDUCIAL MARK ONLY.
3. (B) ORIENT PART BY INNER NOTCH ONLY.
4. (B) NOTE POLARITY/ORIENTATION, LOCATE AS SHOWN.
5. (B) DO NOT WASH PCB ASSEMBLY AFTER POPULATION OF ISO1.
6. (C) ISO1, J1, J2 & J3 SHALL BE FLUSH TO PCB SURFACE AND PARALLEL TO EDGE OF PCB WITHIN ±4°.
7. (C)(D) ASSEMBLY TO CONFORM TO ANSI/IPC-A-610 CLASS II ACCEPTABLE STANDARDS, UNLESS OTHERWISE SPECIFIED.
8. (C) ALL PCB ASSEMBLIES SHALL BE TESTED PER THE TEST SPECIFICATION. A TEST REPORT OR TEST MARKING SHALL BE PROVIDED WITH EACH ASSEMBLY AFTER SUCCESSFUL TEST COMPLETION.
9. (C) U4 & U5 REQUIRE PROGRAMMING PRIOR TO ASSEMBLY. WHEN PROGRAMMED, U4 & U5 SHALL BE PERMANENTLY MARKED ON TOP SURFACE WITH WELCH ALLYN COMPONENT PART NUMBER OR SOFTWARE VERSION NUMBER.
10. (C)(D) COMPLETED PCB ASSEMBLY SHALL BE LABELED WITH WELCH ALLYN ASSEMBLY PART NUMBER, REVISION LEVEL AND DATE OF MANUFACTURE (SEE ITEM 2). CENTER LABEL (ITEM 2) SO NOT TO TOUCH COMPONENTS, TOOLING HOLES, OR OVERHANG BOARD.

(C)	THIS DWG-506	PCB ASSEMBLY, MCU (BOTTOM), REV E & ABOVE
(D)	THIS DWG-505	PCB ASSEMBLY, MCU (BOTTOM), REV D & ABOVE
(C)(D)	THIS DWG-503	PCB ASSEMBLY, MCU (BOTTOM)

MATERIAL:	PART NO.		DESCRIPTION
FINISH:	DRAWN S BUERKLE	10-29-92	Welch Allyn SKANEATELES FALLS, NEW YORK U.S.A.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING TOLERANCES: .XX = ± .02 ANGLES = 01/2° .XXX = ± .008 TOLERANCES PER ANSI Y14.5 REMOVE BURRS & SHARP EDGES EXTERNAL THDS = CLASS - 2A INTERNAL THDS = CLASS - 2B	DESIGNED J HERRMANN	10-29-92	TITLE: PCB ASSEMBLY, MCU (BOTTOM)
	CHECKED DLB	10-29-92	
	APPROVED		CODE IDENT 84476 / SIZE D / DRAWING NO. 236330 / REV F
	REL TO PROD RDS	1-6-93	SCALE 4 : 1 / DO NOT SCALE / SHEET 1 OF 1

D | 236340 | E

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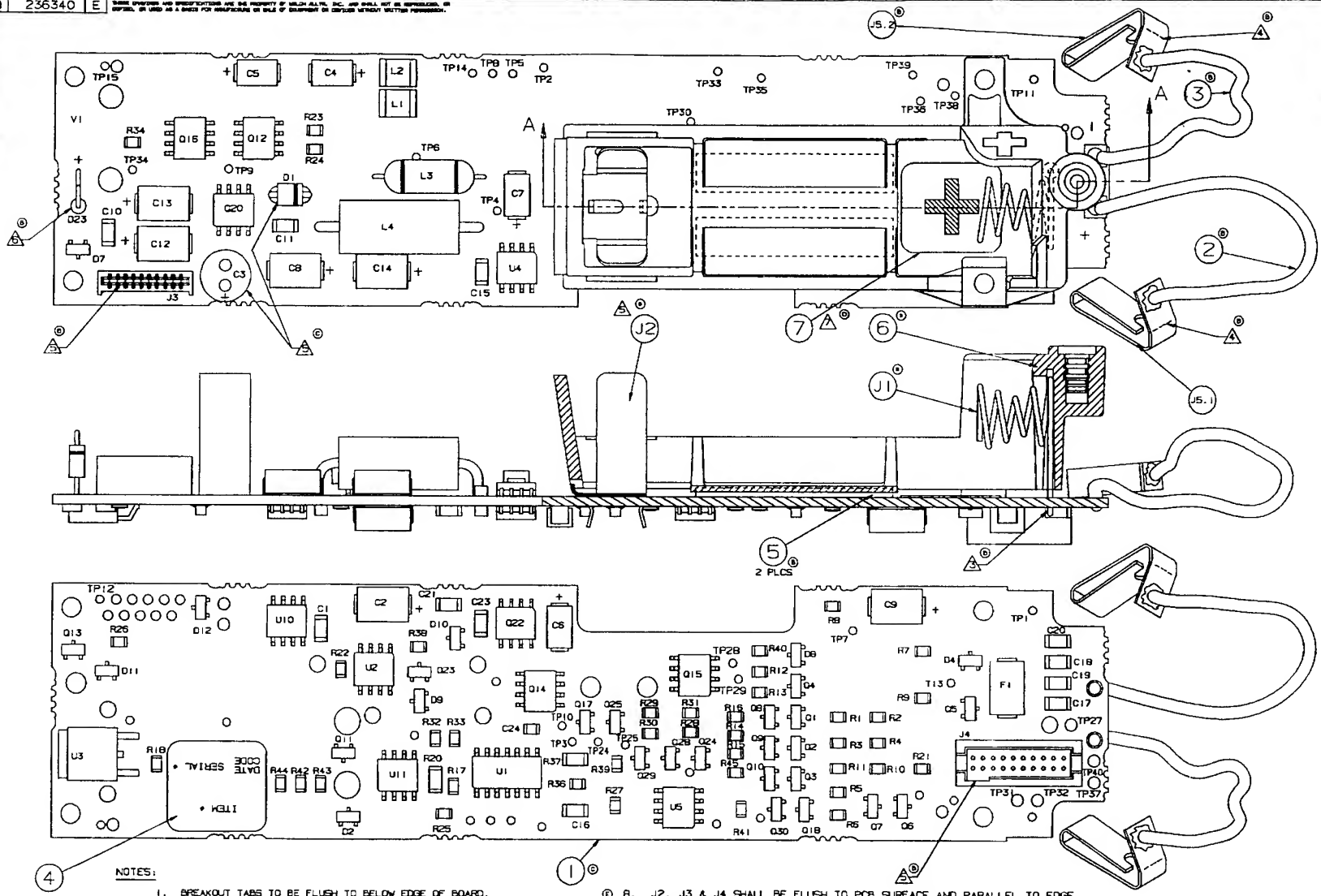
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	REL TO PROD ENG (KB)	E-205200	SB	1-4-93	JRH
B	CORRECTED & REV'D ITEMS 2,3,5 & 8, PLUS J5'S ADDED NOTES 3-6	E-205440	SB	2-23-93	PAG
C	UPDATED COMPONENT PLACEMENT REVD DRAWINGS	E-205480	SB	5-21-93	JRH
D	ADDED ITEM 7, NOTE 7 & SOLDER CUT LINE	E-205822	SB	8-6-93	JRH
E	ADDED NOTES 8 THRU 11	E-207697	SB	10-7-93	JRH



NOTES:

1. BREAKOUT TABS TO BE FLUSH TO BELOW EDGE OF BOARD.
2. SEE B.O.M. FOR POPULATION. "TP" SPECIFIES TEST POINT ONLY. "FID" SPECIFIES FUDICIAL MARK ONLY.
3. TRIM LEAD TO .100 MAX ON ITEM J1.
4. NO SOLDER OR FLUX ALLOWED BEYOND THIS LINE.
5. NOTE POLARITY/ORIENTATION, LOCATE AS SHOWN.
6. APPLY HAIRPIN BEND TO LEAD AT STRIPED END (CATHODE) OF COMPONENT. INSERT SO BODY OF COMPONENT IS OVER CIRCLED AREA.
7. "PLUS" ON ITEM 7 TO BE COMPLETELY VISABLE AFTER PLACEMENT OF ITEM 6, BATTERY COMPARTMENT, ONTO ITEM 1, PCB.
8. J2, J3 & J4 SHALL BE FLUSH TO PCB SURFACE AND PARALLEL TO EDGE OF PCB WITHIN ±4°.
9. ASSEMBLY TO CONFORM TO ANSI/IPC-A-610 CLASS II ACCEPTABLE STANDARDS, UNLESS OTHERWISE SPECIFIED.
10. COMPLETED PCB ASSEMBLY SHALL BE LABELED WITH W.A. ASSEMBLY PART NUMBER, REVISION LEVEL AND DATE OF MANUFACTURE (SEE ITEM 4). CENTER LABEL (ITEM 4) SO NOT TO TOUCH COMPONENTS, TOOLING HOLES, OR OVERHANG BOARD.
11. ALL PCB ASSEMBLIES SHALL BE TESTED PER THE TEST SPECIFICATION. A TEST REPORT OR TEST MARKING SHALL BE PROVIDED WITH EACH ASSEMBLY AFTER SUCESSFUL TEST COMPLETION.

© THIS DWG-502

PCB ASS'Y, POWER SUPPLY, REV C & ABOVE

MATERIAL: ~

FINISH: ~

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
TOLERANCES:
.XX = ± .02
.XXX = ± .005
ANGLES: ±1/2°
TOLERANCES PER ANSI Y14.5
REMOVE BURRS & BREAK EDGES
EXTERNAL THDS = CLASS - 2A
INTERNAL THDS = CLASS - 2B

PART NO.	DESCRIPTION
DRAWN: S BUERKLE 10-29-92	Welch Allyn, SKANEATELES FALLS, NEW YORK U.S.A.
DESIGNED: J HERRMANN 10-29-92	TITLE: PCB ASSEMBLY, POWER SUPPLY (TOP)
CHECKED: DLB 10-29-92	
APPROVED: JRH 2-25-93	CODE IDENT 04476 · D · DRAWING NO. 236340 · REV E
REL TO PROD: RDS 1-6-93	SCALE 4 : 1 · DO NOT SCALE · SHEET 1 OF 1

D | 711700 | G

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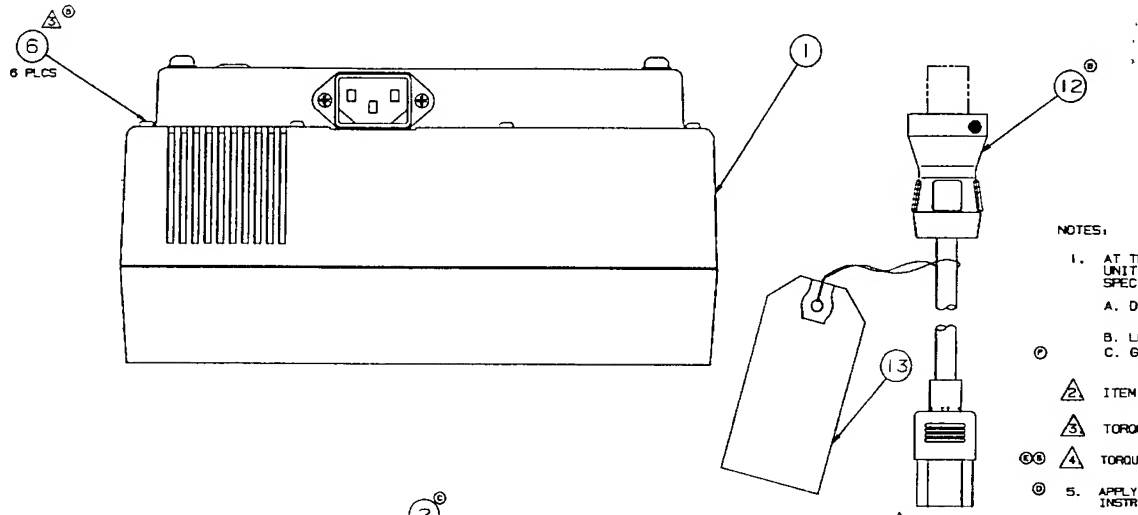
REV	DESCRIPTION	ECN	INIT	DATE	APPR
A	RELEASE TO PROD. ENG. (MF)	P-205440	DLB	12/17/82	PAB
B	MOVED SHEET 2 of 4, REM'D SCREW, ADDED TEXT TO ITEM 15, REPL. ITEM 12, ADD 1 NYLON SCREW, BROKEN OUT VIEW, NOTE 4, & LEFT SIDE VIEW	P-205781	SB	2-16-83	PAB
C	REPL'D ITEMS 2 & 4	P-205888	SB	3-3-83	JRH
D	ADDED ITEM 18 & NOTE 5	P-205840	SB	3-14-83	JRH
E	REV NOTE 4 FROM 14-18 ADDED "OR HAND TIGHT"	P-205888	SB	3-23-83	JRH
F	REV'D NOTE 1 (C)	P-205887	DLS	7-13-83	CCF
G	ADDED -503 & -504	P-205887	SB	9-28-83	



NOTES:

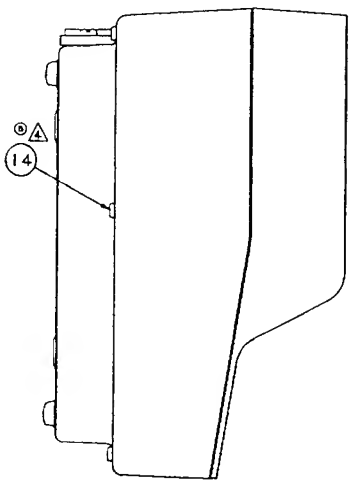
1. AT THE CONCLUSION OF MANUFACTURE AND BEFORE SHIPMENT, EACH UNIT SHALL BE SUBJECTED TO THE FOLLOWING WELCH ALLYN SPECIFICATIONS:
   - A. DIELECTRIC STRENGTH TEST- *A00167, UL/CSA, (1. ONLY) *A00178, IEC. (1. ONLY)
   - B. LEAKAGE CURRENT- *A00171
   - (P) C. GROUNDING CONTINUITY TEST - A02242

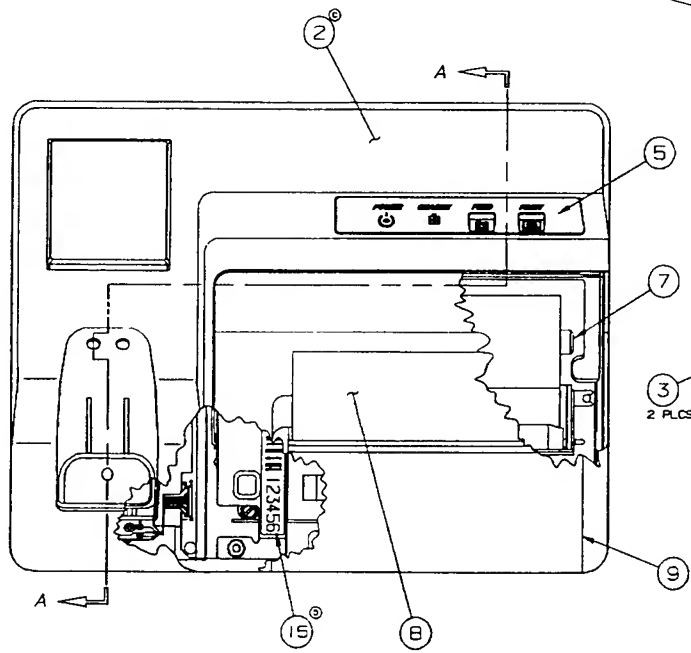
(2) ITEM 5 CABLE TO BE ASSEMBLED WITHOUT TWISTING. ROUTE AS SHOWN.

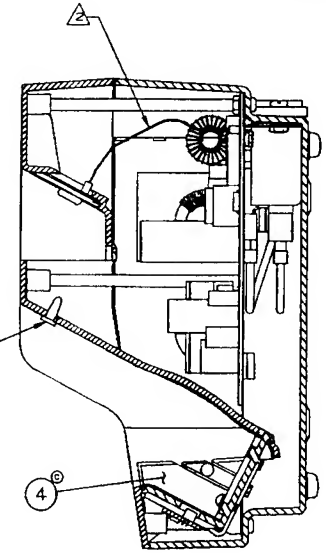
(3) TORQUE SCREWS TO 3 TO 4 IN LB.

(6)(8) (4) TORQUE ITEM 14 TO 5 - 7 IN OZ. OR HAND TIGHT.

(6) 5. APPLY ADDITIONAL BAR CODE LABELS (ITEM 15) PER MANUFACTURING INSTRUCTIONS.







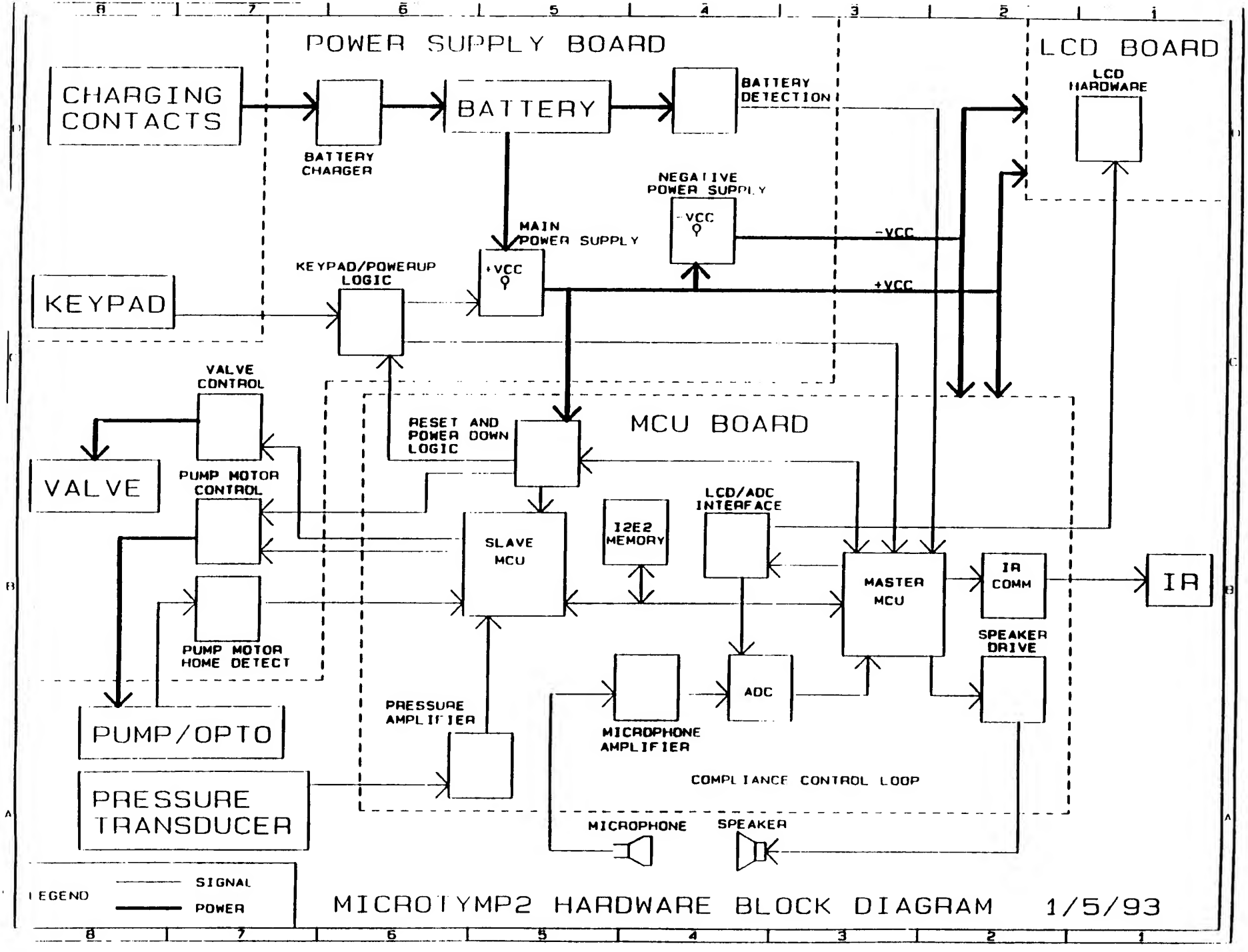
SECTION A-A

(6)	-504	CE MICROTYMP 2 PRINTER/CHARGER W/O CORD OR TAB
(6)	-503	CE MICROTYMP 2 PRINTER/CHARGER DOMESTIC VERSION W/ CORD & TAB
(6)	-502	MICROTYMP 2 PRINTER/CHARGER W/O CORD OR TAG
(6)	THIS DWG-501	MICROTYMP 2 PRINTER/CHARGER DOMESTIC VERSION W/ CORD & TAB

MATERIAL: ~ FINISH: ~

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
TOLERANCES
.XX ± .02 ANGLES ± 1/2°
.XXX ± .005
TOLERANCES PER ANSI Y14.5
REMOVE BURRS & SHARP EDGES
EXTERNAL THDS = CLASS - 2A

PART NO.		DESCRIPTION
DRAWN DLB	12/8/82	Welch Allyn SKANEATELES FALLS, NEW YORK U.S.A.
DESIGNED		TITLE: PRINTER/CHARGER ASSEMBLY
CHECKED JRH	12/8/82	
APPROVED PAB	12/8/82	CODE IDENT 64475 · SIZE D · DRAWING NO. 711700 · REV G
REL TO PROD		SCALE 1:1 · DO NOT SCALE · SHEET 1 OF 1


POWER SUPPLY BOARD
LCD BOARD
CHARGING CONTACTS
BATTERY CHARGER
BATTERY
BATTERY DETECTION
LCD HARDWARE
NEGATIVE POWER SUPPLY
-VCC
MAIN POWER SUPPLY
+VCC
-VCC
+VCC
KEYPAD/POWERUP LOGIC
KEYPAD
VALVE CONTROL
MCU BOARD
RESET AND POWER DOWN LOGIC
VALVE
PUMP MOTOR CONTROL
LCD/ADC INTERFACE
SLAVE MCU
12E2 MEMORY
MASTER MCU
IR COMM
IR
PUMP MOTOR HOME DETECT
SPEAKER DRIVE
PUMP/OPTO
PRESSURE AMPLIFIER
ADC
MICROPHONE AMPLIFIER
COMPLIANCE CONTROL LOOP
PRESSURE TRANSDUCER
MICROPHONE
SPEAKER
LEGEND
SIGNAL
POWER
MICROTYMP2 HARDWARE BLOCK DIAGRAM 1/5/93

SECTION 11

A 02727 -- PROCESS SHEET EXCERPTS FOR 23641 MICROTYMP 2 HANDLE TESTS

SECTION 12

A-02728 Process Sheet excerpts
for 71171,71172,71174,71176,71179
Micro Tymp 2 Printer Charger tests